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10th October, 1932. 9052

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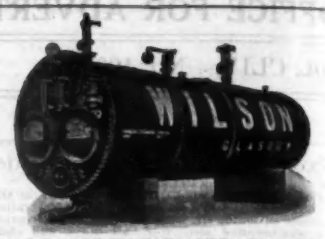

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The list of preferences which the Dominions now grant to British goods under the terms of the Ottawa Agreements were published on Wednesday night. Their general effect is to give to Great Britain an improved preferential advantage amounting to something over £51 million, of which £14 million are represented by Canadian concessions, £11 million by Australian, and £21 million by Indian. As far as the engineering industries are concerned the greatest satisfaction will be felt with the Canadian free list, in which appear aluminium, a wide range of iron and steel products, many classes of machinery, engines for tractors, lorries and omnibuses, Sheffield goods, motor vehicles, various kinds of electrical apparatus, and oil and steam engines. Whilst the other Dominions do not, as far as we can see at present, give new total exemptions from import duties, they grant substantial reductions and preferences. The general effect of these agreements was expressed in a resolution of the Conference, which runs :—"That by the lowering or removal of barriers among themselves provided for in these agreements, the flow of trade between the various countries of the Empire will be facilitated, and that by the consequent increase of purchasing power of their peoples the trade of the world will also be increased. Further, that this Conference regards the conclusions of these agreements as a step forward, which should in future lead to further progress in the same direction, and which will utilise protective duties to ensure that the resources and industries of the Empire are developed on sound economic lines." Mr. Bennett introduced the agreements in the Canadian Parliament at Ottawa on Wednesday, and as they were at once ratified they are already in force in that Dominion. They will come before the House of Commons early next week. Mr. Bennett is reported to have said : "After almost half a century of hopes and fears and vain endeavour, the countries of the British Empire have come together and reached an agreement based on a principle of mutually advantageous tariff preferences, and have by their common trust and zeal prepared the way, not only for the practical working out of the existing agreements, but also for their augmentation at such times as our interests may suggest."

Steel Wheel Plant for Russia.

The Sheffield firm of Davy Brothers, Ltd., has obtained an important contract of the value of £202,000 from Arcos, Ltd., of London, for an installation for the manufacture of railway wheels which is to be erected at the Dzerjinsky Works at Dnepopetrovesk, near Zaporjie, in South Russia. The order was secured only after very extended negotiations, in consequence of the special credit terms required by the customer, and it was gained in the face of keen Continental competition. It will be executed in conjunction with the Edgewater Steel Company, of Pittsburg, Pa.; Taylor Brothers and Co., Ltd., of Trafford Park, Manchester, and with the assistance of the Government Export Credit Scheme. The work of manufacture will extend over nine months, and will take place in the company's Sheffield works, and partly in Glasgow at the works of Duncan Stewart and Co., Ltd., in order to complete the contract within the period allowed by the Export Credit Scheme. The plant will comprise a group of three Davy patented high-speed steam-hydraulic forging presses of 2500, 3000 and 7000 tons respectively, which are to be used for punching and slabbing the sliced ingot block, and thereafter forming the shape of the wheel, and corrugating the wheel web after rolling. A high-power wheel rolling mill of the Edgewater type, constructed under the Bell patents, will be employed for finally rolling the rim and the tread on all four sides. The contract also includes all handling machinery and hydraulic plant required for carrying out all the processes in one heat.

The French Motor Liner Aramis.

The recently completed motor ship "Aramis," which has undergone official trials and will shortly be commissioned, was built by the Société des Forges et Chantiers de la Meditérranée for the service of the Messageries Maritimes. She is one of six motor ships, including the ill-fated "Georges Philippar," which have been added to the company's fleet, and two further ships are now under construction and will be completed early next year. The "Aramis" has an overall length of 567ft., with a beam of 69ft. 9in. and a depth of 47ft. to C deck, with a loaded draught of 27ft. 9in. at 21,550 tons displacement. Her measurement is about 15,000 gross tons. A feature of the safety and navigating equipment and the engine-room auxiliary plant is the inclusion of a good deal of machinery and apparatus of British manufacture. The main propelling plant comprises a twin-screw arrangement of Sulzer, ten-cylinder, two-stroke, single-acting engines, with a total output of 11,600 S.H.P. at 110 r.p.m. The cylinders have a bore of 680 mm. with a stroke of 1200 mm., and were constructed at the St. Denis works of the French Sulzer company. There are auxiliary generators of 2000 kW capacity, oil engine driven, and auxiliary boilers utilise the waste heat from the exhaust gases. Accommodation is provided for 1076 passengers. An unusual feature of the vessel is the provision of two square funnels, with a bridge between them forming a passenger gangway. The ship is built to Bureau Veritas requirements, and complies with the London International Convention.

Water and Fires in London.

The subject taken for his Presidential Address to the Institution of Engineers-in-Charge by Lieut.-Colonel J. D. K. Restler, on Wednesday last, October 12th, was "The History and Development of the Water Supply and Fire Protection of London." The subject was a fitting one, for Colonel Restler's family has for nearly a hundred years been directly connected with the water supply, and indirectly with the protection against fire of London and its surrounding areas. The address dealt in an interesting way with the early history of these two allied services, and an outline was given of the activities of the New River Company and the Chelsea, Lambeth, Grand Junction, West Middlesex, East London, Kent, and Southwark and Vauxhall undertakings, which from 1609 up to 1845 preceded the Metropolitan Water Board, founded nearly thirty years ago. Colonel Restler went on to describe the various measures taken for the protection of London against fire, and dealt in some detail with the training of firemen. The last section of his address consisted of a short descriptive note of some of the more noteworthy London fires, with some of the lessons which they have taught. Stress was laid on the necessity of making fire drill conditions as much like those of actual fires as possible.

The New Cunarder.

Although as yet no official announcement has been made, it would seem from statements which have appeared concerning the Cabinet meeting on Tuesday last that no assistance either by subsidy or guarantee is contemplated to enable work to be resumed on the Cunader No. 534 now on the stocks at John Brown's yard, and to make possible the laying down of a sister ship. It is found difficult, we understand, to single out one shipping company or industrial undertaking for financial help without opening the way for further applications. Nevertheless, it would appear that there are many members of the Cabinet and the Government who are of the opinion that the work given by constructing the two Cunarders would go far towards allaying unemployment distress, both in shipbuilding and other industrial centres concerned. Our arguments for this course of action were given in a leading article published in our last issue. No doubt when Parliament assembles on October 18th something further will be heard with regard to the Government's decision on this matter.

The British Industries Fair.

In view of reports which have recently appeared in the daily Press with regard to the withdrawal of the £25,000 Government publicity grant to the British Industries Fair, it has been thought advisable to issue a brief authoritative statement with regard to the present position of the Fair, and we have received such a statement from Sir George Gillett, who, it will be recalled, was Secretary to the Department of Overseas Trade in 1929 to 1931. Sir George points out that, contrary to any reduction in the Fair activities, the display next February promises to be larger than ever. Already 344,290 square feet of space have been applied for at Olympia and at the White City, an increase of more than 35,000 square feet on last year. At Birmingham the available space has been fully booked without even approaching exhibitors, and new sections are now having to be organised outside the main buildings at Castle Bromwich. All facts point to a larger exhibition next year than ever before. Some exhibitors may doubt the true economy of cutting off the £25,000 advertising grant and the adequacy of the suggested scheme for replacing part of this grant. On this point an official announcement is, we learn, shortly to be made. Meanwhile many thousands of buyers have been invited to attend the Fair, and have been informed of its scope, and it is certain that next February will see buyers from home and overseas, as in previous years, flocking to the Fair centres.

Co-operation in Transport.

In his presidential address to the Institute of Transport in London on Monday evening last, October 10th, Sir David J. Owen dealt mainly with the problem of port costs. After considering the various factors of capital cost, the nature of trade at ports, mechanical appliances, the subsidy of ports, labour costs and other miscellaneous items, Sir David concluded his address with a survey of the future of the transport industry and a strong plea for co-operation in all public utility services. There was, he held, still scope for considerable scientific research as regards co-operation between all branches of transport. The comprehensive title of the Institute of Transport made it necessary for that Institute to grapple with transport as a unified whole, and so to create a proper atmosphere in which the problems now arising could be dealt with in an enlightened manner. The railway, the road vehicle, the commercial aeroplane, and the coastal and ocean-going ships, were all capable of rendering a definite service to the country, and each should only be called upon to perform the work for which it was best suited. Sir David concluded by saying that he visualised a day not far distant when the legitimate function of each of the various methods of transport would be clearly defined and regulated in the best interests of national needs. In that picture the docks and harbours would be seen in their proper perspective, acting as efficient links between sea transport on the one side, and the various forms of land transport on the other.

Wolverhampton Waterworks Extension.

On Monday last, October 10th, the Corporation's new waterworks at Dimmingsdale, some 4¼ miles from the town, were formally opened by the Mayor of Wolverhampton, Alderman J. Haddock. The plant has a designed output of 3,000,000 gallons per twenty four hours, and the supply is taken from two bore-holes 1025ft. in depth, which are steel-lined to a depth of 250ft. The pumping plant comprises water-tube boilers, with chain grate stokers, and slow-speed, triple-expansion pumping engines. The pumps have a total head of 610ft. and raise the water from 250ft. below ground level to 360ft. above that level. Other plant includes a steam turbine-driven centrifugal pump of half the capacity of the main set, and three electrical generators. The reinforced concrete buildings, which include a coal wharf and a tramway haulage track, were begun in May, 1930. The total cost of the scheme, including £11,640 for a pipe line 3670 yards long, is £82,400. The work was initiated by Mr. E. A. B. Woodward, the late water engineer who retired in 1926, but the present engineer, Mr. B. L. McMillan, has been solely responsible for the design and construction of the new works.

The Kembs Power Station.

On Sunday last, October 9th, the large hydro-electric power station at Kembs, on the river Rhine below Basle, and the first section of the Alsace Canal, were formally opened by Monsieur Albert Lebrun, the President of the French Republic. A full description of the canal and the hydro-electric plant was given in The Engineer of August 26th last. The power station, which will be completed next year, will, it is claimed, be the most powerful in Europe, its annual output eventually reaching about 700,000,000 kW hours. It has been designed to serve the whole of the eastern area of France. The cost of the whole installation has been given at about 670 million francs or nearly £5,200,000 at par, while the cost of the barrage alone, which has been built by the State, has amounted to 150 million francs, or about £1,200,000. The canal, which extends from a point on the Rhine about 3 miles from the Swiss frontier to Strasburg, provides a means of ensuring regular navigation on the Rhine at all seasons, while utilising the 108 m. difference of water level between Basle and Strasburg for the production of something like 900,000 horse-power.

The Dnieper Power Station.

On Monday last, October 10th, the hydro-electric power station on the river Dnieper was formally opened. This power station is claimed by the Soviet to be the largest in the world at present, and will be equipped with nine 60,000-kW turbo-generators, of which five are already working. The auxiliary plant includes two 3000-kW generators. The turbines and alternators were constructed at the Schenectady works of the General Electric Company of America, Colonel Cooper being the technical adviser for the scheme. The foundations of the station were laid in November, 1927, and since that time not only has the station been built but a number of metallurgial works and an entirely new town have been brought into being. Where three years ago only bare steppes existed, a large industrial unit has now been created, with twelve factories, including aluminium works and metallurgical plants. The power station will supply current to all these factories, as well as the neighbouring towns of Dnieperopetrovsk and Zaporozhye. The following figures give some idea of the magnitude of the undertaking, for the construction of which it was necessary to transfer about 100,000 peasants to other parts of the country. The concrete used in the dam amounted to 43,200,000 cubic feet. More than 3000 workers have been employed on the scheme, which has taken five years to complete. Alongside the dam a new town with a population of 120,000 people has come into being. The construction of the dam has raised the level of the upper part of the Dnieper by about 130ft., making navigation possible over the entire river. The barrage has forty-eight openings and the water gates each weigh about 48 tons. On the left bank of the river locks have been constructed, while across the dam at a height of 52 m. a wide road has been built connecting the industrial districts. The cost of construction of the power station alone is approximated at £22,000,000, which sum does not include the cost of building the various works and adjoining new towns.

LARGE INTERNAL CYLINDRICAL GRINDER

JOHN HOLROYD AND CO., LTD., ROCHDALE, ENGINEERS

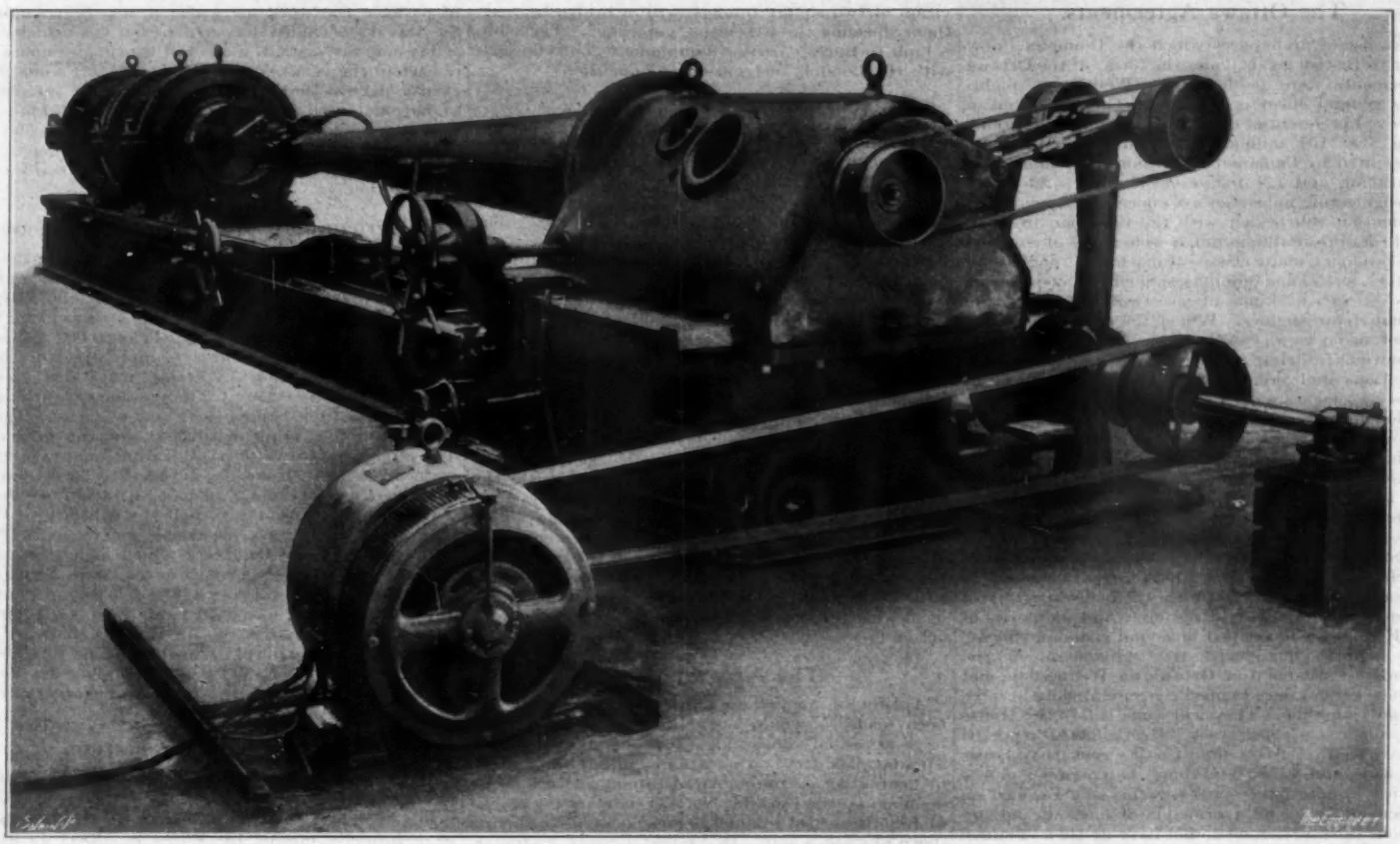


FIG. 18—VIEW FROM DRIVING END

Precision Grinding Machines.

No. IV.

THE demand for grinding machines is still very much on the up grade, and in consequence old machines are constantly in course of improvement, and new productions are as constantly being put on the market. The machine illustrated by Fig. 19 belongs to the latter class, and is made by John Lund, Ltd., of Cross Hills, near Keighley. It differs from many other external grinding machines of the same type in having hydraulic operation of an unusual large number of movements, comprising the work headstock, the table traverse, the feed, rapid movement of the wheelhead, the tailstock and the engagement of the table traverse. As will be seen from the illustration, the controls for all the motions are neatly collected together on a panel at the front of the bed. Owing to the use of hydraulic drives, nearly all the motions are infinitely variable as to the speed. The headstock, for instance, provides any work speed between 0 and 450 r.p.m. It has a live spindle and dead centre, and can be arranged to take chucks. In the same way, the table traverse speeds may be varied infinitely between 0·03ft. and 40ft. per minute, while the high speed available makes the advantageous use of wheels up to 8in. in width possible. In addition, when plunge cut grinding is undertaken, the table may be reciprocated to and fro over a distance of as little as 0·2in. at any speed up to 40ft. per minute, the reversals being quite smooth and vibrationless. The productive capacity of the machine is much increased by the hydraulic operation of the tailstock from a pedal, which, when depressed, withdraws the centre. If required, it may also be operated by hand, but in either case it is immovable when either the wheelhead or the workhead on the table is in motion. At the time when the tailstock centre is withdrawn for the insertion of the work, the wheelhead is rapidly withdrawn hydraulically by about 2in., returning after the piece has been mounted exactly to its former position. These movements are accurately limited by a stop in the interior of the cylinder. For grinding tapers the upper table may be set over up to an angle of 8 deg., and accurately put in position by the use of a micrometer screw mechanism. The grinding wheel is belt driven from a 25 H.P. motor mounted within the base, while the oil for the hydraulic system is maintained at a constant temperature by passing it through a radiator ventilated by a separately motor driven fan. Besides a loose, removable, settling tank for the coolant, there is also a large supply tank from which the coolant is drawn by a motor-driven pump of 26 gallons per minute capacity. Work pieces up to 10in. in diameter and 40in. in length may be ground.

* No. III. appeared October 7th.

CYLINDRICAL GRINDING, INTERNAL.

In many ways the internal cylindrical grinder is a more interesting machine than the external. The problems of design to be solved in the making of an external grinder are not so much mechanical difficulties as problems of averaging wear and tear, and devising straightforward mechanisms of high accuracy. Most of them were solved when the lathe and the planer were being designed long before the grinding machine had become anything more than a manufacturers' dream. The designer, it is true, had to modify these solutions to suit his own particular purposes, but it was not until he set his hand to the construction of internal grinding machines that he was confronted with new problems. Then he found himself forced to erect a bridge over the bed of the machine so that the table could pass beneath the wheel, and erect thereon the wheel head. Not only had he to extend a bar, as rigidly made as possible, into the bore of the work, but he had also to pass a spindle down that bar and drive at the end of this long overhanging support a wheel which it was required should revolve at high speed. In addition, the transverse movement or feed of the wheel had to be ten times as accurate and delicate as the corresponding movement on the lathe. It is a matter almost for wonder that he was so successful as to produce a practical and not merely an impossibly expensive laboratory machine. But the construction of the planetary type grinding machine is an even more astonishing feat. The external grinding machine, with its ability to support its work at both ends, can with a fair amount of ease deal with oddly shaped pieces; nor is it often confronted with jobs that are difficult to handle, whereas the internal grinding machine is faced by pieces of all shapes and sizes. Few things, for instance, can be of a more awkward shape to swing than a cylinder block. The boring machine got over the difficulty by planting the work firmly on a table and causing the tool to rotate, exactly reversing the motions of the lathe. The makers of grinding machines, with great boldness, did the same, in spite of the fact that to make a grinding wheel follow a planetary path involved complicated problems in the design of the

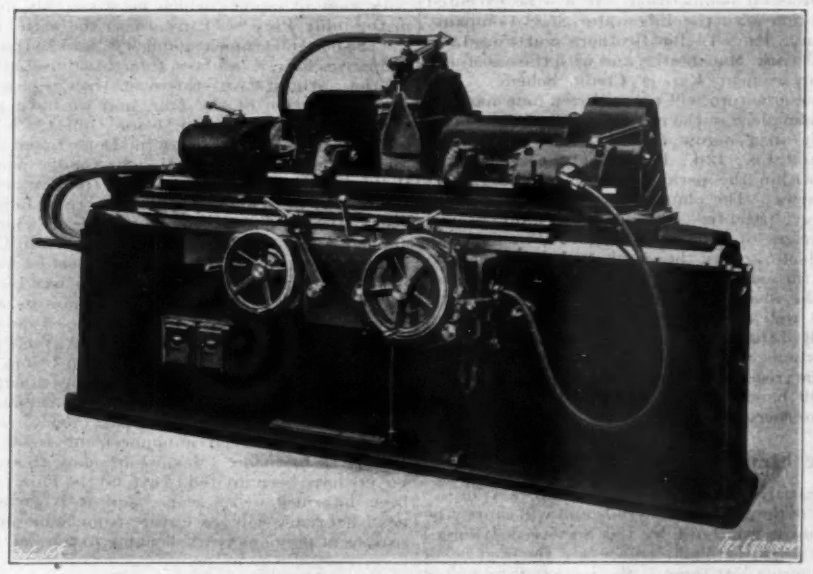


FIG. 19—LUND HYDRAULIC EXTERNAL GRINDER

grinding head. They combined on the wheel head itself no less than four motions, the rotation of the wheel, the planetary path of the wheel, the feed of the wheel involving an alteration of the planetary path, and the longitudinal traverse. No similar problems confront the makers of external grinding machines for general work, although for special purposes, such as cam, cutter, and gear grinding, the difficulties are equally numerous.

Many of the principles of which account must be taken if external cylindrical grinding is to be performed successfully and economically apply with equal force to internal grinding. The use of wide

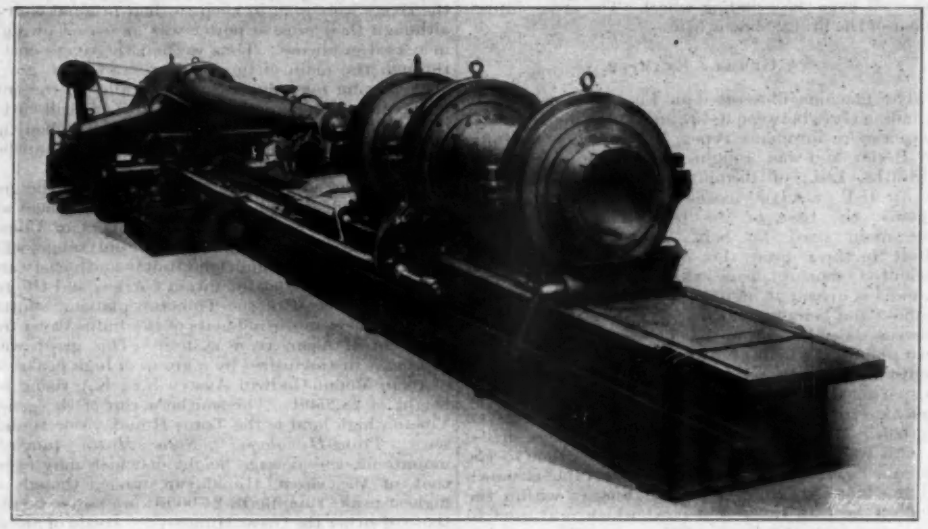


FIG. 20—HOLROYD INTERNAL GRINDER—VIEW FROM WORK END

wheels in conjunction with a high table speed leads to rapid production. In general, the best practice favours a wheel width of about ⅜in. for diameters up to 3in., and a width of 1in. or more for larger diameters. For use with such wheels, the traverse speed of the table should be at least 9ft. per minute. A few years ago it was considered that satisfactory internal grinding operations could not be performed, except by the use of very high spindle speeds. That the belief was erroneous is proved by the number of machines now utilising speeds no higher than 1500 r.p.m. Nevertheless, while realising that grinding at such low speeds is possible, many makers consider it preferable to run the spindles at speeds up to 20,000 r.p.m. When the spindle runs at a low speed it is of very great importance that it should be mounted in a sufficiently rigid manner. The work speed has a considerable effect upon the finish, but little influence on the output of the machine, unless it is so low as to restrict the rate of traverse. A speed of 100ft. per minute is frequently adopted. Too low a speed is likely to cause glazing of the wheel. The diameter of the grinding wheel to be used for any job depends to a large extent upon the circumstances. In general, it will be nearly that of the hole for small work, while for large bores, the relation, bore to grinding wheel diameter, is usually about 3 : 2.

The important difference between the internal and external grinding machine is, of course, the fact that whereas in the latter the wheel can be firmly supported by a bearing or bearings, mounted directly on the frame closely adjacent to it, in the former the wheel must be placed at the end of an overhanging support, which, however well constructed, must suffer from a certain lack of rigidity. In such circumstances, doubt must exist as to the value of an automatic "sizing" cross feed. Although the slide can be set to a predetermined position with great accuracy, it does not necessarily follow that the hole being ground will reach the required dimensions. The position being what it is, no surprise can be felt that while some makers incorporate such an automatic cross feed in the design, others do not. As in external grinding, it is of great importance that overrunning of the wheel beyond the ends of the work should be avoided. Apart from the fact that its occurrence results in a loss of time, and in consequent reduced production, it has also a deleterious effect, both upon the work and upon the wheel. In external grinding, the sharp edges of the work tend to shear away the face of the wheel, while in internal grinding the spring of the wheel mounting may cause the work to be ground bell-mouthed.

A Large Internal Grinder.

In some of the largest internal grinding machines, the design certainly owes something to the development of the planing machine. For instance, the movement of the work table of the machine illustrated in Figs. 18 and 20 is very similar indeed to that of a planer. This large internal grinding machine is made by John Holroyd and Co., Ltd., of Rochdale, and is designed to work in conjunction with the large external grinding machine which we described in an earlier article. The bed is constructed in two pieces firmly bolted together, one supporting the work table and the other carrying the wheel head. The sliding ways are fitted with rollers at intervals with the object of ensuring good lubrication. The work table slides on the bed, and carries the stays which support the work. Each of the work stays is movable on the table, and is provided with split taper collets, which grip the outside of the work and revolve in the stays. It is therefore of great importance that the external surface should be ground to size before operations upon the bore are put in hand. If the external grinding is accurate, the arrangement ensures that the bore is co-axial with it. Special arrangements of lubricating rollers are incorporated in the design. The central stay forms the driving head. The main belt drive is provided by a constant speed motor mounted independently of the machine at the end of the bed furthest from the work table. A gearbox, which provides ten changes of speed and feed, is interposed between the belt countershaft and the longitudinal driving shaft at the back of the bed. The longitudinal shaft drives the centre stay by means of spiral gearing. The driving pinion may be withdrawn from one side of the stay and placed on the other side, so that if it is necessary the work may be reversed. The bed, it should be noted, is big enough to take work which is too long to be ground from one end only. The reversal is facilitated by the fact that the collets are interchangeable in the bearings of the stays. The longitudinal traverse motion of the work table is provided by a feed screw contained between the two sides of the bed. Rapid power traverse and hand traverse motions are also available. At the end of each stroke the table comes up against a dead stop and the continued rotation of the screw with the consequent end movement actuates the reverse motion.

The wheel head has cross movement on the bed with micrometer and quick hand adjustment. The spindle is of steel and runs in gun metal ring-oiled bearings, and the conical-shaped snout carrying the overhang of the spindle has one side formed parallel with the axis of the machine. The spindle is driven from the main countershaft by an arrangement of belting by which the tension is maintained automatically as the wheel head is cross traversed. Immediately above the main countershaft there is a second shaft mounted on an arm capable of swinging about the axis of the first. The drive to the spindle is taken from a pulley on this second countershaft, the supporting arm of which is linked to the wheel head. Stepped pulleys provide four changes of speed for the emery wheel. The cross feed of the grinding head is operated automatically at each end of the stroke by a ratchet wheel and screw. Examination of the engravings will show that as far as is possible on so large a machine, the controls have been grouped together in front of the grinding head. The table above gives some dimensions and data not previously mentioned.

Max. diameter of work	30in.
Min. diameter of work	18in.
Max. length of work	20ft.
Max. length of work ground at one setting	10ft. 9in.
Max. size of emery wheel	16in. by 1½in.
Min. size of emery wheel	10in. by 1½in.
Diameter of emery wheel-spindle	2½in.
Speeds of emery wheel, r.p.m.	1350, 1540, 1760, 2000
Speed of work (ten changes)	3 to 16 r.p.m.
Longitudinal traverse of table (ten changes)	2·77–23·3in. per min.
Quick traverse of ditto	5ft. 3in. per min.
Automatic cross feed (ten changes)	0·0005in. to 0·005in.
Length of table	16ft. 6in.
Power of motor	15 H.P.
Speed of motor	960 r.p.m.
Floor space occupied	41ft. by 12ft.

Typical Chucking Grinder.

The machine just described is of so large a size as to be in some respects exceptional. Yet the essential

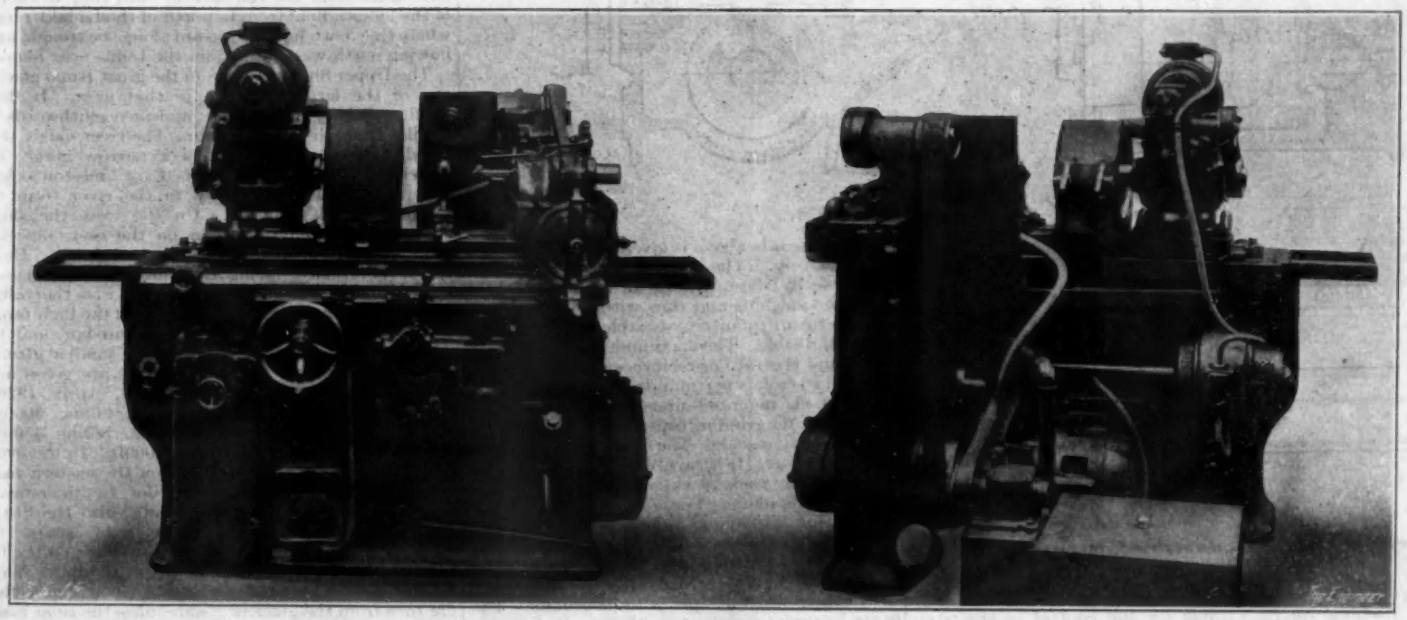


FIG. 21—FRONT AND REAR VIEWS OF SMALL CHURCHILL INTERNAL GRINDING MACHINE

similarity between it and the smaller machine illustrated by the tone engraving, Fig. 21, can easily be traced. This machine—tiny as compared to that of Holroyd's—is one of a range of such tools made by the Churchill Machine Tool Company, Ltd. It is capable of dealing with work up to 12in. in external diameter and is a recent production of the firm. With the exception of a separate coolant tank it is entirely self-contained, and the main driving motor and the various controls are mounted on the bed. The machine differs from the more normal type of chucking grinder in that it is fitted with a table similar to those usually installed on "Universal" grinding machines. As is usual in small internal

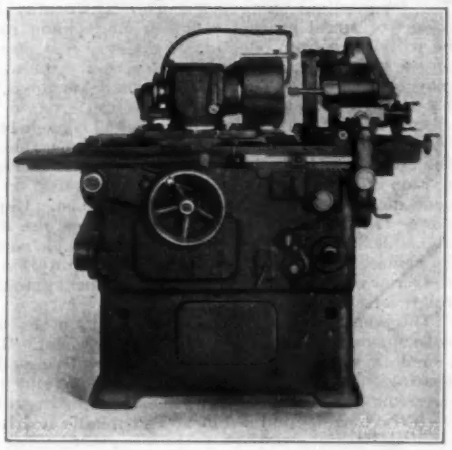


FIG. 22—JUNG SMALL INTERNAL GRINDER

chucking grinders, the work head can be swivelled. In addition, the whole table can be rotated about a pivot at its centre and securely clamped in any position within the limits of swing by the thumb wheel to be seen at its left-hand end. The provision of a swivelling table makes possible the grinding of long pieces supported in a three-point steady in addition to ordinary chucking work.

The table is traversed hydraulically by a cylinder and ram mechanism, the piston-rod of which is secured to the table, whilst the steel cylinder is fastened to the bed. Instead of the usual hydraulic leathers, the bore of the cylinder is lapped and the piston is fitted with rings of the automobile type.

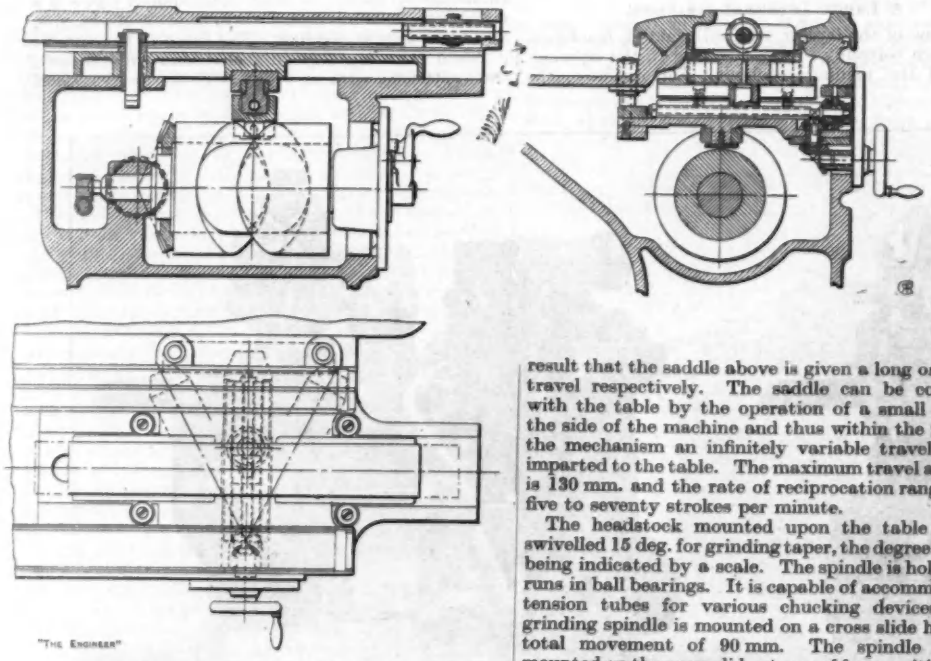


FIG. 23—TABLE RECIPROCATING MECHANISM

Three levers on the panel to be seen at the front of the machine are responsible for the control of the table. The upper one, causing reversal of its motion, can be operated by adjustable limit trips; immediately below the reverse lever is mounted that for starting and stopping the motion, while the third operates the throttle regulator and gives any speed from the minimum up to the maximum of 35ft. per minute. Oil for the hydraulic mechanism is stored in a reservoir at the right-hand end of the bed. The gear pump which maintains the oil pressure is driven by a chain running in a totally enclosed oil bath from the main drive shaft at the rear of the machine. A hand wheel at the front of the machine moves the table independently of the hydraulic gear and is of particular use when setting up.

The features of the work head drive are best seen by reference to the view showing the back of the machine. A small generator is driven by chain from the main drive shaft and is connected electrically with a variable-speed motor mounted on the work head. Switchgear mounted on the front of the bed incorporates "start" and "stop" push buttons and gives an overall speed range control of 6–1. From the variable-speed motor the drive is through spiral gears running in an oil bath to a short lay shaft, whence the work head spindle is driven by a 1¼in. belt. The grinding spindle is carried on a heavy bridge slide which is supported and guided by flat and "V" guiding surfaces. When the table is run back for examination of the work a guard, trip operated and mounted on a hinge, automatically drops into position over the grinding wheel. The cross adjustment of the bridge slide is 5½in.

A German Example.

The machine illustrated in Fig. 22 is capable of grinding bores between 0·4in. and 4·0in. diameter and is of a more automatic type. It is made by K. Jung, of Berlin, and was brought to our notice by Burton, Griffiths, Ltd., of Birmingham. It is driven by a 3½ H.P. electric motor mounted at the back against the base of the bed. This motor drives the main shaft by belt. At the end of this shaft furthest from the driving pulley there is mounted another, from which the grinding wheel spindle is driven at high speed. The arrangement of pulleys and belts by which the speed of the spindle is increased can be seen in the engraving. Between the two pulleys the main shaft passes through a gear-box containing two trains of gears. The first, providing six changes, drives a drum within the base of the machine from which the work head spindle is driven by belt. The second, providing eight changes, drives a cam which gives the reciprocating motion to the table. The drive from the cam to the table is shown in the line engraving, Fig. 23. Fitting within the slot of the cam there is a pawl which is caused to reciprocate by the shape of the cam. This pawl is attached to an arm capable of swivelling about one end. Above the rocking arm there is mounted a saddle, which is driven by the rocking arm *vid* another pawl, itself attached to a nut encircling a rotatable screw mounted on the rocking arm. The screw can be rotated from a hand wheel inserted in the base of the machine. This hand wheel drives the screw through two pairs of bevels, the two intermediate bevels of which are mounted on a shaft set coaxial with the centre of oscillation of the rocking arm. Thus, while the mechanism is in operation the nut can be traversed out to the end of the rocking arm or back almost to the centre of oscillation, with the result that the saddle above is given a long or a short travel respectively. The saddle can be connected with the table by the operation of a small lever in the side of the machine and thus within the range of the mechanism an infinitely variable travel can be imparted to the table. The maximum travel available is 130 mm. and the rate of reciprocation ranges from five to seventy strokes per minute.

The headstock mounted upon the table can be swivelled 15 deg. for grinding taper, the degree of taper being indicated by a scale. The spindle is hollow and runs in ball bearings. It is capable of accommodating tension tubes for various chucking devices. The grinding spindle is mounted on a cross slide having a total movement of 90 mm. The spindle can be mounted on the cross slide at any of four positions, the most suitable for the majority of jobs being that furthest from the front of the machine. It is necessary to use the others when a taper is to be ground. The spindle can be run at speeds up to 25,000 r.p.m.

Mounted upon the table on a swivel is a diamond wheel trueing device, which can be brought into operation when the table is run back. A ratchet device allows the wheel to be trued up by a definite amount for every piece of work, the position of the diamond being set to correspond with the required work diameter.

An automatic hydraulic feed of the cross slide giving a maximum movement of 0·6 mm. can be set to complete the grinding of the work within any period between thirty seconds and twenty minutes.

(To be continued.)

Shyok Glaciers and Indus Floods.

By J. M. LACEY.

The glacial dam that forms across the Shyok River was again brought into prominence by the floods in the Indus River during July of this year.

The Himalayas consist of sedimentary rocks, and the direction of the mountain ranges is determined by the rockfold movements. The ranges are regular and parallel and the rocks being soft, the denudation is very rapid. The uplifting of the mountains was a gradual process, protracted over a very long period, and had a very marked effect on the river system. During the slow process of uplift, folding, and faulting, the rivers were able to keep to their original courses, although their erosive power was increased owing to increased gradients. Thus we find the rivers cutting through the main chains in deep transverse gorges, after flowing for long distances parallel to the trend of the mountain chains. The streams are still cutting down the river beds, and have not yet reached their bed level. The valley sides are steep and landslides frequently occur.

On the north and north-west of Kashmir the great watershed which separates the Indian drainage area from that of Yarcand and other rivers of Chinese Turkestan is the Mustagh (ice mountain) range, which with the Karakoram high land trends south-eastwards, forming a continuous mountain barrier, and the true water-divide west of the Thibetan plateau, shutting off the sources of the affluents of the Indus River from the Central Asian river system. This great water parting is distinguished by a group of high peaks, one of them Mount Godwin Austen (*i.e.*, K_2), rising to a height of 28,250ft. The southern rim of the general Tibetan high land is the Trans-Himalaya or Hedin—see "*Trans-Himalaya*," *Sven Hedin*—range of mountains, the average height of which may exceed that of the Great Himalayan range, though the highest peaks running to 24,000ft. are not so great as those of either the Great Himalaya—Abode of Snow—or the Karakoram. South of the Trans-Himalaya lies the deep trough of the Indus, the Sutlej and the Brahmaputra rivers. The Trans-Himalaya forms the watershed between the plateau of internal drainage to the north and the region of the sources of the rivers of India mentioned above.

The Indus, after flowing in a north-westerly direction, turns south near Bunji in Gilgit and cuts its way through the Great Himalayan range in a westerly direction, after which it pursues a general south-westerly direction to the sea. As the river works its way in its gorge round the base of the Great Nanga Parbat, towering to a height of 26,620ft., the bed of the Indus is only 3000ft. above sea level, while the crests of the mountains on either side rise to 20,000ft.

The Shyok River.

The Shyok River rises near the southern foot of the Karakoram range; two important streams, the Nubra and the Upper Shyok, with their affluents, flow south from the Karakoram until they reach one of the longitudinal troughs north of the Ladakh range, where they both join the stream along the trough, and, flowing north-westwards, join the Indus near Skardu.

The Upper Shyok rises from the great Rimo glacier, one of the largest glaciers in that area. It flows south-east for some distance, and then southwards for 9 miles through a broad plain. The river valley then rapidly contracts and enters a narrow gorge, the eastern face of which is formed by limestone cliffs, which fall almost vertically to the river from the Dipsang massif (Fig. 1). On the west the slope, though less precipitous than on the east, descends steeply from the main Karakoram heights. Down the deep divides, facing the vertical cliffs, glaciers creep, forcing their massive snouts across the valley. Three important glaciers descend from the high range, the Chong Kumdan, the Kichik Kumdan, and the Aktash. South of the latter are two smaller glaciers of no importance. Their dimensions are given as—*Himalayan Journal*, Vol. I., No. 1, April, 1929—the Chong Kumdan, 9 miles long, falling 3000ft.; the Kichik Kumdan, 7 miles long, falling 3500ft.; the Aktash, 5 miles long, falling 2000ft. In the event of heavy accumulation of snow on the eastern main range these three glaciers, owing to their steep beds, advance suddenly and rapidly into the Shyok gorge. On occasions they flow right across the river until they strike the precipitous cliffs on the left bank. Sometimes the force of the water above maintains a channel past the snouts by erosion, and icefloes are torn from the glaciers; sometimes the river maintains a channel under the ice; at other times the glaciers not only extend across the whole width of the Shyok, but they turn down the river bed for hundreds of yards and completely block the river, forming a dam of solid ice across the Shyok. Then water begins to accumulate behind the ice dam until a huge lake is formed, which in time overflows, or where a weak line occurs right through the breadth of the glacial barrier, the dam cracks and the pent up waters are released, causing a sudden flood down the river.

Fig. 1 is a sketch plan of the Shyok area, and Fig. 2 is a diagram sketch of the Upper Shyok showing the important glaciers. The actual extent of the Rimo glacier is not known, recent observations showing that the northern Rimo throws a tongue over the

Central Asian watershed and feeds the Yarcand River.

Near the confluence of the Nubra the elevation is about 10,000ft. and the Shyok here has a fall of about 18ft. a mile. The bed of the river here is composed of shingle and small boulders, and is not uniform, rapids alternate with pools. The Nubra has a fall of about 12ft. per mile. At Saser Brangsa, where there is a ford, the elevation of the Shyok is 15,000ft., and above Saser Brangsa it has a fall of about 40ft. per mile ("*Chong Kumdan Dam and Shyok Flood of 1929*," *J. P. Gunn*).

The routes to Thibet and Ladakh from India follow

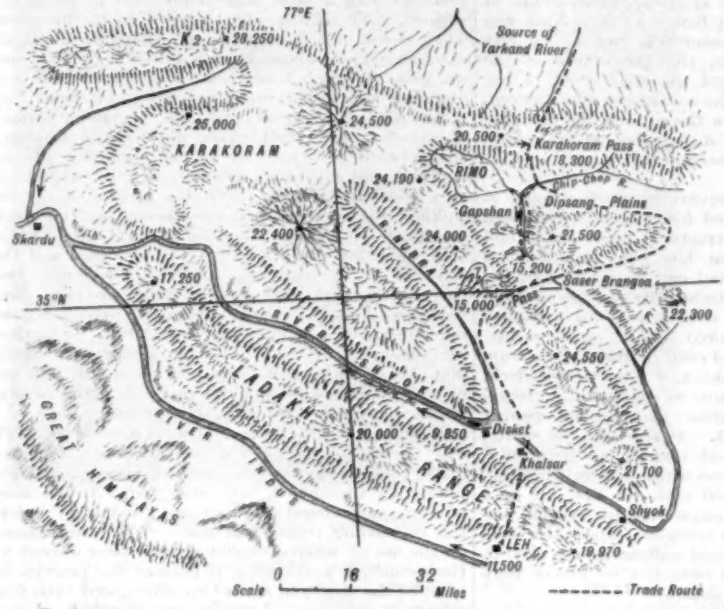


FIG. 1—SKETCH PLAN OF THE SHYOK AREA

the levels of the Himalayan Valleys, with no remarkably steep gradients, until they arrive near the approach to the watershed. The slope then becomes steeper with the ascending curve to the summit of the pass, from which point it falls with a comparative gentle gradient to the general level of the plateau. The normal trade route from Leh to Central Asia over the Karakoram pass is up the Shyok River, past the glacier mentioned, to the Gapshan (Yapchan) grazing grounds near the Rimo confluence, and then along the Chip Chap. The advance of these glaciers frequently makes the section impassable, with the

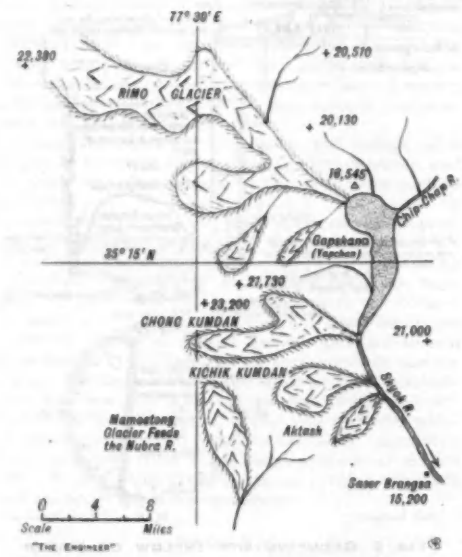


FIG. 2—PLAN OF UPPER SHYOK AREA

result that Caravans have to make a long detour over the barren Dipsang plains.

THE FLOODS.

The first recorded damming of the Shyok occurred in 1779, and the water broke through in the following year, causing a flood down the Indus. The evidence regarding the damage caused is scanty. In 1812 the Kumdan glaciers were again advancing across the valley, and a complete dam was formed in 1834. In 1835 a great flood occurred down the Indus by the bursting of the dam, but the ice closed and once more blocked the valley. The flood is reported to have caused serious damage to riparian lands up to the confluence of the Indus and Gilgit rivers near Bunji. No damage was caused below that point. There appears to have been another flood in 1839.

There is a difference of opinion regarding the great flood in the Indus in 1841. It is now ascribed to an earthen dam formed across the river Indus by the fall of a spur of the Nanga Parbat. The obstruction was supposed to be 1000ft. deep and to have completely closed the river, forming a lake 40 miles in length. It gave way in June, 1841. Prior to the bursting of the dam, the Indus at Attock was fordable, and a Sikh army was encamped on the plain of Chach, near Attock, close to the river. At 2 p.m. early in June, the roar of the water coming down the river was heard, and before the soldiers could reach safety, the river came down like a wall, giving an immediate rise of 80ft., and sweeping every thing before it. The height of the flood was believed to be 92ft. above low winter level, and 42ft. above normal high flood level of summer. The lake emptied itself in twenty-four hours (see *Himalayan Journal*, Vol. I., No. 1, April, 1929, "*Indus Floods and Shyok Glacier*," *Major Kenneth Mason*; see also "*Proc.*," *Inst. Civil Engineers*, Vol. 230, page 257 and page 261, "Reconstruction of the Attock Bridge").

The next great flood occurred in 1858. At Attock the Indus rose earlier that year than usual, and at the time of the flood was not fordable. The annual flooding of the river is due in July and August, when the water normally reaches a height of 50ft. on the gauge at Attock. On this occasion the river rose 55ft. in 7½ hours, and reached a height of 80ft. above its cold weather level, or 12ft. below the level of the flood of 1841. The waters took forty-eight hours to pass Attock. This flood was reported to be caused by a landslide in the Gilgit River, which joins the Indus near Bunji, and not to the bursting of a Shyok glacial dam.

Every four or five years a barrier of ice seems to have formed across the Shyok, resulting ultimately in a burst if the river did not find its way under the ice. In April, 1902, Sven Hedin—"Adventures in Thibet," Sven Hedin (1899–1902)—on his way to Thibet, found the snout of the Kichik Kumdan glacier several yards from the cliff, while the snout of the Chong Kumdan was over 30 yards back from the river bed. In the following winter caravans could still get past the Kichik Kumdan. The valley was blocked in 1903, the spring water forming a lake which eventually burst the dam. In 1908 the three glaciers advanced across the Shyok valley, and completely blocked it; disaster was averted by water percolating through the ice.

The glaciers do not appear to have caused obstruction to the trade route for some time, and for six years preceding 1925 the route was open to caravans. In June, 1925, the Roosevelt expedition found the Shyok valley blocked by the Chong-Kumdan glacier, and was forced to turn back, and make a detour over the Dipsang Plains. Early in June, 1926, the valley was reported to be blocked by two glaciers, a lake had been formed upstream, and by August had extended to Gapshan, a distance of 6 miles from the barrier. The block appears to have been complete, as early in October there were only 2ft. of water in the Shyok at the Saser Branjsa ford. The dam burst at the end of October, and the Thirit suspension bridge, some 150 miles below the lake, was carried away. In the gorge some 30 miles below the Nubra confluence the flood is said to have risen to 70ft. above normal flood level; the gorge acted as a flood moderator and backed the water some 10 miles up the broad Nubra Valley (see also pages 261 and 262, "*Proc.*," *Inst. Civil Engineers*, Vol. 230). Some caravans in the Nubra Valley were reported to have been destroyed, and low-lying lands along the river were covered with boulders and *débris*. No great damage was experienced at Skardu, 350 miles from the lake. Bunji, some 130 miles lower down, suffered no ill-effects. At Attock the river rose 20ft. on October 23rd, at noon (*vide* Fig. 3, page 239, "*Proc.*," *Inst. Civil Engineers*, Vol. 230).

Great alarm was caused in 1928 when it was reported that the Shyok Glaciers were again blocking the river, and preparations were made to evacuate low-lying ground in the Indus Valley. Mr. Ludlow examined this area early in August of that year, and found the terminal pinnacles of the Aktash Glacier about 200 yards from the river, the Kichik Kumdan pinnacles more than 100 yards from the river bank, whilst the Chong Kumdan Glacier had completely blocked the river, and its snout had spread for 500 yards down the main valley. The lake up river extended to the Chip-Chap confluence, and for 3 to 4 miles up it, giving a total length of approximately 10 miles. The lake at its widest part was 1½ to 2 miles broad; southwards to the gorge it narrowed to a breadth of only a few hundred yards. On August 2nd the lake had risen 1½ft. in twenty-four hours (*Himalayan Journal*, Vol. I., No. 1, April, 1929).

Mr. J. P. Gunn, of the Punjab Public Works Department, visited the lake in 1929. He found the Chong Kumdan Glacier completely blocking the river. In his opinion, this glacier is responsible for all the Shyok floods. It issues from a side valley of considerable width, where the hills on both sides of the Shyok are much nearer than is the case at the snouts of the Kichik Kumdan and the Aktash glaciers. He estimated the total depth of water above the dam to be 400ft.; the valley above continues to narrow for 4 miles and then widens out considerably, so that the top 100ft. depth of water in the lake had a volume twice as great as that of the lower portion. Mr. Gunn estimated the capacity of the lake as 1,095,500 acre-feet.

In July when he crossed, the river the bed above the Kichik Kumdan was absolutely dry; he reached the upper portion of the Gapshan Lake, as it is called, on August 5th, travelling *vid* the Dipsang Plains.

During his stay there the lake rose 5·9ft. in 211 hours. He returned *vid* the Dipsang Plains on the 14th, and reached Saser Brangsa on the 17th, to find the Shyok in flood with ice scattered about the river bed. The ice barrier had broken in the early hours of August 15th; subsequent inspection showed that the lake had emptied itself through a gully about 400ft. wide with almost vertical sides, through a line of weakness that began near the right bank on the upstream face of the barrier, and after a curved course came out near the left bank on the downstream face.

The flood reached Saser Brangsa, 10 miles below the dam, at 6 a.m. on August 15th, and rose 85ft. in 4 hours, to about 10 a.m. The statement below shows the rate of rise and fall of the flood at Saser Brangsa:

Date, 1929.	Time.	Hours.	Flood levels.
August 15th	6 a.m.	0	Level normal
August 15th	10 a.m.	4	+85ft. above normal
August 15th	11 a.m.	1	+85ft. above normal
August 15th	5 p.m.	6	+33ft. above normal
August 16th	5 p.m.	24	+24ft. above normal
August 17th	6 a.m.	13	Level normal
Total		48	

It thus took 48 hours to empty the lake.

The two statements below compare the rate of the flood wave down the Indus due to the Shyok floods of 1926 and 1929:—

Flood of 1926.

Stations.	Distance, miles.	Time, hours.	Velocity, m.p.h.
Diskit to Skardu	153	16	9·56
Skardu to Bunji	96	8	12
Bunji to Chilas	47	5¼	8·55
Chilas to Attock	242	25	9·68

Diskit is at the Shyok-Nubra confluence.

Flood of 1929.

Stations.	Distance, miles.	Time, hours.	Velocity, m.p.h.
Saser Brangsa to Khalsar	130	22	5·91
Khalsar to Skardu	165	16	10·31
Skardu to Bunji	96	14	6·857
Bunji to Attock	289	29	9·965

In 1929 the flood wave passed down the Indus during the flood season, whereas in 1926, the flood wave passed down when the flood season was over and the river was falling. (See also Fig. 3, page 239, Vol. 230, "*Proc.*," *Inst. Civil Engineers*.)

Most of the damage in 1929 was done between Khalsar and Skardu. At Khalsar in the Valley of the Shyok-Nubra confluence, the flood rose 45ft. in half an hour from 8 a.m. on August 16th to 8.30 a.m. At 10 a.m. it again rose 18ft. suddenly, making a total rise of 63ft. By the morning of the 17th it had completely passed. At Skardu on August 16th at 6 p.m., the gauge reading was 17ft., at 9 p.m. 25ft., and at midnight 42ft. On August 17th at 3 a.m. the gauge reading was 42ft. and at 7 a.m. 35ft.

The flood reached Bunji at 5 a.m. on August 17th. On the evening of that day the Attock gauge was 27·5, the flood arrived at 2.15 a.m. on the 18th, and rose to 44ft. on the gauge by 8 a.m. By 11 a.m. it had risen to 54·5ft. and the peak of 56ft. was reached at 6 p.m., giving a rise of 28·5ft. in 16 hours. The gauge remained steady at peak for 2½ hours, and then began to fall and reached 28ft. on the gauge at 8 a.m. of the 21st. ("*Report on the Chong Kumdan Dam and Shyok Flood of* 1929," *by J. P. Gunn.* Government of India Publication.)

Lower down the flood passed Dhera Ghazi Khan, and the Muzaffargarb district without causing any appreciable damage.

The bursting of the Shyok Glacier Dam did not give the flood that was expected down the Indus, but it had the result that in anticipation of the flood the river banks were strengthened. Towards the end of August, 1929, heavy rainfall in the Himalayas in the basin of the Indus, and floods in the Kabul and Haro rivers caused an abnormal rise of the Indus. At Attock the river rose from 37ft. on the gauge on Tuesday, August 27th, to 51ft. at 8 a.m. on Wednesday, the 28th, by 2 p.m. there was a further rise, and at 6 p.m. 63ft. was registered on the gauge, with the river still rising. The maximum reached was 66·5ft. on the gauge or 6·5ft. above the previous recorded flood of 1882.

The flood discharge was estimated to be 817,000

cusecs at Attock with an average velocity of 13·2ft. per second. Against 841,478 cusecs, the estimated discharge of the Shyok flood of August 18th, the difference being due to the considerable heading up of the Indus on the 28th by the Haro River, which joins the Indus below Attock. (See "Reconstruction of the Attock Bridge," "*Proc.*," *Inst. C.E.*, Vol. 230, pages 255, 256, and page 267.)

Considerable damage occurred in the Muzaffargarb district; the flood embankment in Dera Ghazi Khan on the right bank held, but the canals in the district suffered severe damage from floods in the hill torrents coming down the Suliman hills on the west of the district and discharging into the already flooded Indus. Extensive areas were flooded and thousands rendered homeless. Fourteen inches of rainfall is reported to have fallen at Fort Munro in the Dera Ghazi Khan district and 12in. in twenty-four hours at Sukkur. In the Chenab and the Jhelum areas the floods did considerable damage to crops and cattle in villages in the riverian areas and to some canals.

The gully formed in the Chong Kumdan glacier during 1929 appears to have closed, and the glacier once more blocked the Shyok. Captain C. E. Gregory inspected the barrier in 1931. He states that on July 4th of that year the water at Saser Brangsa was only 1ft. deep; the Gapshan Lake at that time was 10 miles long, and varied from 1 to 1½ mile in width. In this month of July the lake was 35ft. to 40ft. below the highest erosian marks, and rising 6in. to 7in. a day. The width of the Chong Kumdan snout, against which the water of the lake was resting, was about 1500 yards, and the snout extended for a distance of 1100 yards below the point where the eastern edge of the lake meets the ice. The height of the ice across the lake was about 200ft. Here it was a mass of pinnacles, which extended for 3 miles up the glacier, the height of these pinnacles was from 60ft. to 80ft. high (*Himalayan Journal*, Vol. IV., April, 1932).

Fig. 3 is a sketch from a photograph showing the

FIG. 3—SNOUT OF CHONG KUMDAN GLACIER

snout of the Chong Kumdan glacier across the Shyok valley, and the lake forming beyond it.

Flood of July, 1932.—Information was received from Leh that the Shyok ice barrier had again broken and water was rapidly rising in the Indus. At Skardu the river is reported to have risen 18ft. in an hour, at Bunji it had risen 30ft. above normal, at Attock the highest reached was 50·7 on the gauge. Owing to the system of warnings introduced in 1929 no loss of life or cattle or damage to property has been reported.

Experts find great difficulty in forming any conclusion regarding the periodicity of the advance and retreat of these glaciers. The Karakoram is a region of glaciers, which are now remnants of the enormous ice and snow fields which formerly must have covered the whole of this western area. From the shape of the Shyok valley it is evident that at one time the glaciers reached the Shyok-Nubra confluence at an altitude of about 10,000ft.

The snow line at the Karakoram is from 17,000ft. to 18,000ft., and glaciers extend their snouts to altitudes of 15,000ft. to 16,000ft.; and only observations in the region where the great Chong Kumdan glacier is situated will show whether it has recently shown signs of retreating. Major Mason considers that after 1932 there will be no danger of a block for another thirty years (*Himalayan Journal*, Vol. IV., April, 1932).

The New Water Supply Tunnel for New York City.

No. II.*

Shaft Sinking.

Preliminary to starting shaft sinking, hoisting equipment, consisting of a stiff-leg derrick, with either compressed air or electric drive, was placed at each shaft. The intention was later to substitute permanent headframes and large electrically operated mine hoists as soon as the shaft sinking had progressed far enough to permit the erecting of such headframes in safety. Owing to delays in delivering parts of the proposed equipment, some of the shafts were sunk to tunnel grade and the derricks were used for all excavating and concreting work. Where permanent headframes were provided, they were set in the positions designed for them in aiding tunnel construction and were temporarily utilised for shaft sinking. The headframes consist of latticed steel towers, 10ft. by 15ft., that rise 42ft. above the ground level. Each tower is surmounted by a hoist-house containing a mine hoist having a drum of 7ft. or 8ft. in diameter and driven by a 250 H.P. D.C. motor and a motor generator set for furnishing the current.

For convenience in handling the eight to ten drills used by each shift of workers engaged in shaft sinking, the contractor devised a frame of steel that has served both as a rack for holding the drills and their air hose, and as a manifold with air and water outlets—see Fig. 7. When ready for use, each of these frames has carried all the necessary drills and connections, and after being lowered into a shaft it has been necessary only to couple the main air and water lines to make the drills available for immediate use.

In most instances, the chamber excavations at the shafts were completed before shaft sinking was begun. Where ground water was but a few feet below the ground surface, the excavating of the chamber was deferred until the completion of the shaft and tunnel. Where the water table was approximately a score of feet below the surface, the chamber was excavated to a point slightly below the ground water level and the shaft caisson was started at that elevation.

Wherever chamber excavations were wholly in earth, the support provided for the earth has been steel sheet piling with structural steel wales and braces. This construction has been found more economical than timber, and can be exposed to the weather for some years without fear of deterioration. Furthermore, the use of steel has greatly reduced fire risks and has required fewer replacements. Following the completion of each chamber excavation and the start of shaft sinking, a solid timber deck, supported by heavy I beams, was laid at the ground level to cover the excavation, save for an opening to give access to the shaft. At three of the shafts, where the earth penetrated ranged in depth from 55ft. to 70ft., there were two stages of steel sheeting. The excavation was started with the first lift as a square opening, and the succeeding lift, within the square, was changed to an octagon. The wales were of heavy H beams. Diagonal stiffeners were used in the corners of the square sets, but no braces were provided in the octagonal shafts.

South of the East River, where bedrock along the line of the tunnel lies from 68ft. to 140ft. below the surface of the ground, the shaft-sinking procedure differed. The ground water surface at nearly all the shaft sites in this section of the project is approximately at the elevation of the bottom of the valve chamber excavations, or just where shaft sinking began. The overburden in this region is a modified glacial drift through which ground water can move with comparative freedom. Shaft sinking in these circumstances was carried to bedrock by means of pneumatic caissons. Eight of the nine caissons employed in shaft sinking in Queens and Brooklyn were identical in their general dimensions and features, differing only in height because of the varying depths of the water-bearing sand and gravel that had to be penetrated before reaching solid rock. The caissons—see Fig. 6—were circular, constructed of concrete, and equipped at the bottom with a cutting edge of structural steel and concrete. Each caisson had walls 3ft. thick in which were embedded both vertical and circumferential square twisted bars for reinforcement. The vertical reinforcement was of 1¼in. rods in two rings respectively, 21ft. and 24ft. in diameter, and with the rods spaced about 12in. apart. The interior diameter of each caisson was 19ft. The working chamber was formed by a temporary reinforced concrete deck, placed about 8ft. above the cutting edge. The deck was penetrated by two vertical steel shafts—one 4ft. in diameter, for handling excavated materials, and the other 3ft. in diameter, which was used by the workmen to reach and to leave the chamber. Air locks were fitted at the top of each of these tubes. The construction of a caisson was started by erecting the cutting edge on the carefully levelled bottom of the shaft chamber excavation. Steel forms were used for both the inside and outside of the caissons, but inside forms of wood were employed to a point above the top of the working chamber deck. The deck was poured monolithic with the walls—their reinforcing rods being anchored in the caisson concrete. The steel forms utilised for the concrete caissons and for shaft lining were in units 5ft. high, each of which was composed of four segments bolted together along the vertical joints. Wooden spacers, about 3½in. wide, were placed in two joints to complete a full circle. These spacers served as keys to facilitate the subsequent removal of the forms.

Sinking was started usually when the walls of a caisson had reached a height which made further pouring of concrete either difficult or inconvenient. Additional concrete was added as a caisson sank until the caisson attained its required height. With the removal of earth from under the cutting edge, a caisson would at first sink by reason of its own weight, but as penetration increased and frictional resistance augmented, additional weight was needed to carry the caisson downward. When this stage was reached, water was placed inside the caisson above the working chamber deck. Frequently this supplemental deadweight sufficed, but at times it was necessary to increase the weight of the caisson further, and steel rails stacked on the deck or on the caisson rim were employed for this purpose. During erection and sinking, the part of a caisson that extended above the bottom of a shaft chamber was supported by rubbing blocks that were backed against the wales and braces of the chamber excavation. These blocks served to steady the caisson and to hold it perpendicular while it was sinking. Inasmuch as all the caissons had to be seated at least 5ft. below the lowest point of sound rock, considerable amounts of rock at times had to be excavated under compressed air. That work was done by familiar open-cut methods, but shallower holes were drilled and lighter charges of explosives were used than would have been the case elsewhere.

The caissons were seated in each instance upon a concrete pedestal consisting of an annular block of concrete with a steel angle embedded in its upper surface. The cutting edge dropped on to this angle when at rest in its final position. Above the pedestal, extending for a distance of not less than 4ft. over the seat, there was constructed a concrete collar of a diameter that would provide a space of about 2in. between the face of that collar and the outside surface of the caisson. Grout pipes, leading into this 2in. space, were incorporated in the structure of the pedestal, and when the pipes were themselves grouted as a concluding operation in the process of caisson sinking, the seal between the caisson and the rock was made complete. The concrete for the pedestal and the collar was placed in wooden forms, and the erection of the forms, the pouring of concrete, and the grouting were done under compressed air. Provision was made for anchoring each caisson to the outer lining of a rock shaft by extending the vertical reinforcement of the caisson for a depth of about 30ft. below the cutting edge. A sleeve nut was left on the lower end of each vertical rod of the caisson reinforcement for attaching the anchorage steel.

Where the shafts were excavated in rock the work was carried on by well-known methods, but wet drills were used, and the time-saving drill carrier, previously mentioned, was employed. At the start of work, each round was shot and "mucked" before the succeeding round was shot. When restrictions on the use of delayed exploders were later waived by the municipal authorities, it became the practice at most of the shafts to shoot two, three, and even four rounds at one time. Leakage into the shafts during excavation was cut-off as soon as the water began to interfere with the progress of the work. At times in a number of the shafts water was encountered in drill holes at the shaft bottoms, in quantities that called for special methods to check or to stop the flow. On those occasions a number of holes were drilled in the bottom of a shaft, grout pipes were firmly fixed into them, and a heavy concrete plug, through which the pipe projected, was placed in the shaft bottom. When the concrete had set sufficiently, all the pipes were grouted to refusal—see Fig. 5. For the fore-

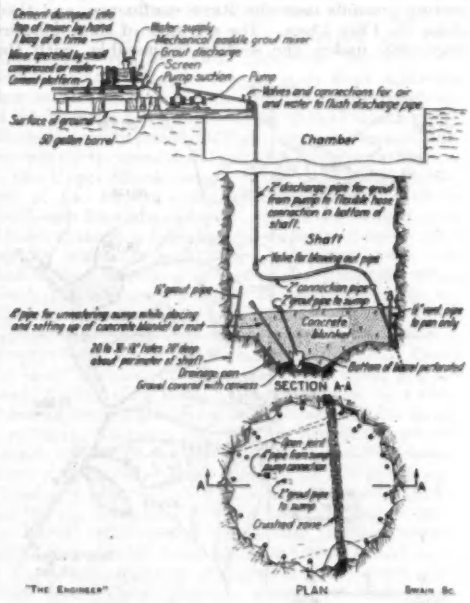

Cement dumped into top of mixer by hand 1 bag at a time
Mixer operated by small compressed air motor
Covered platform
Water supply
Mechanical paddle grout mixer
Grout discharge
Screen
Pump suction
Pump
Valves and connections for air and water to flush discharge pipe
Surface of ground
50 gallon barrel
Chamber
2" discharge pipe for grout from pump to flexible hose connection in bottom of shaft.
Shaft
Valve for blowing out pipe
¾" grout pipe
2" connection pipe
2" grout pipe to sump
4" pipe for unwatering sump while placing and setting up of concrete blanket or mat
Concrete blanket
6" vent pipe to gun only
10 lb. I-6" holes 10' deep about perimeter of shaft
Drainage gun
Gravel covered with canvas
Bottom of bucket perforated
SECTION A-A
Gun vent
2" pipe from sump pump connection
2" grout pipe in sump
Crushed rock
A
PLAN
"The Engineer"
Swain &c.

FIG. 5—GROUTING-OFF INFLOW OF WATER

going operations, the equipment utilised consisted of a mechanical grout mixer and a pump situated at the top of the shaft. The grout was discharged from the mixer into an open container, which supplied the pump suction, and the grout was pumped down the shaft through pipe or hose of large diameter. In this manner the grout was delivered continuously to the connection at the bottom of the shaft and at any desired pressure.

Where shafts or shaft sections are in earth, and were constructed by means of caissons, the walls of the caissons, when seated, formed the outer linings for the earth sections. All other parts of the shafts have been lined by placing concrete behind circular forms. Heavy reinforcement, consisting of vertical rods and horizontal hoops, was placed in the linings of the shafts in earth, but the linings of rock shafts have been made of plain concrete except for the anchorage sections of the caisson shafts. Linings in rock shafts

* No. I. appeared October 7th.

NEW YORK WATER SUPPLY—NEW TUNNEL

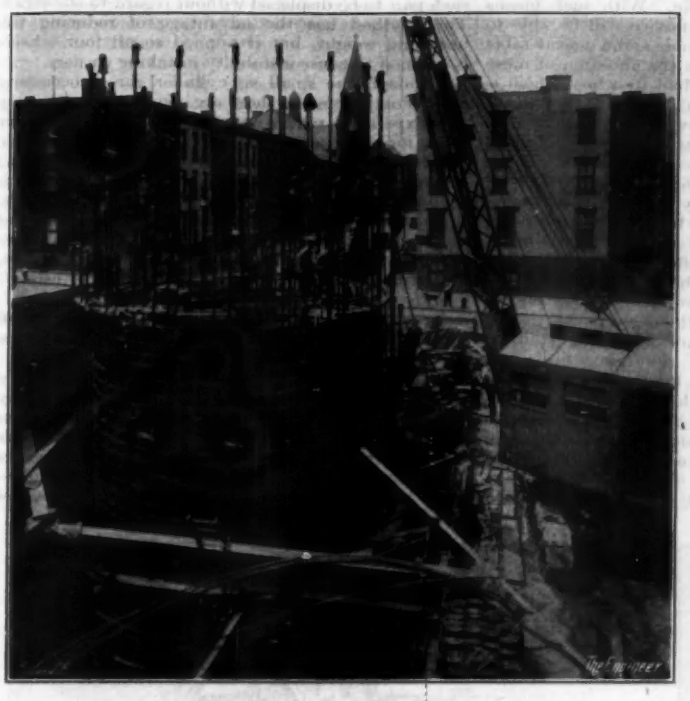


FIG. 6—REINFORCEMENT FOR A 190-FOOT CAISSON

FIG. 7—PORTABLE DRILL FRAME

were usually placed as soon as 60ft. to 80ft. of shaft had been excavated. The first form for such a concreting operation was set on the levelled off muck in the shaft bottom, and when this form was filled other lifts were added. The work was thus continued until closure with the underside of the completed lining above was made. Closure was effected with a wooden form of special construction. Service pipes, ranging from 1in. to 6in. in diameter, were embedded in the shaft lining to serve the contractor during tunnel driving. Eventually, these pipes will be filled with grout. The mixing of concrete was done by portable paving mixers, which were moved from shaft to shaft as required. The concrete materials were brought to the mixers by motor trucks from a central batching plant. A rich mixture was used. Because no storage facilities were available at any of the shafts, either for excavated materials or concrete aggregates, the contractor has maintained a large fleet of motor trucks to ensure continuity of the work. These trucks have been mainly of a self-dumping type and of 5 tons capacity. The trucks used for hauling muck are equipped with plain box bodies, while those employed in transporting concrete materials have bodies divided into four or six compartments by swinging partitions.

During shaft-sinking operations, the linings were grouted at intervals to cut off the inflow of water, and this work was always done in any case after a shaft had been sunk to tunnel gradient. As would be expected, the grouting was done under moderate pressures in the upper sections of the shafts, but below the elevation of the riser valves, where the outer lining is the final lining of the shaft, high pressures were used. To prevent the leakage of grout at the bottom of a shaft, in order that high-pressure grouting might be effectively carried out, it was the practice to seal the underside of the lining either by a concrete blanket over the whole bottom of the shaft or by a concrete collar between the underside of the lining and the solid rock. The blanket or collar was removed when the grouting was completed. Grouting operations were conducted from a platform suspended in the shaft. Neat cement grout of special cement was used in all the shaft grouting operations.

SHAFT 9A

Shaft 9A, situated on the south shore of the East River, is 547ft. deep, and because of its designed functions in connection with the operation of the finished tunnel, it is both larger and different in construction from any of the other shafts. When finished, this shaft will control the delivery of water by means of one 48in. and one 72in. riser. Furthermore, it will contain a dry well, 12ft. in diameter, which will give access to the pump chamber, and also numerous pipes and conduits associated with the control of the section valves and the unwatering equipment. Therefore, to accommodate the different apparatus, the major part of the shaft, which is in rock, was made approximately elliptical, namely, 22ft. by 26ft. The part of the shaft that is in earth is circular in section and of a diameter slightly greater than the long axis of the ellipse. This shaft is formed by a caisson having walls 4ft. thick and an interior diameter of 28ft. It has three rings of vertical reinforcement, instead of two as in the case of the smaller caissons, and a correspondingly larger number of reinforcing hoops.

The chamber excavation for Shaft 9A was not dug first, as at other shafts, and the caisson was started at the ground surface. Wooden forms were used instead of metal forms, and the deck over the working chamber was built at a higher elevation and was different in design from those in the other caissons. During sinking, it was more difficult to maintain the

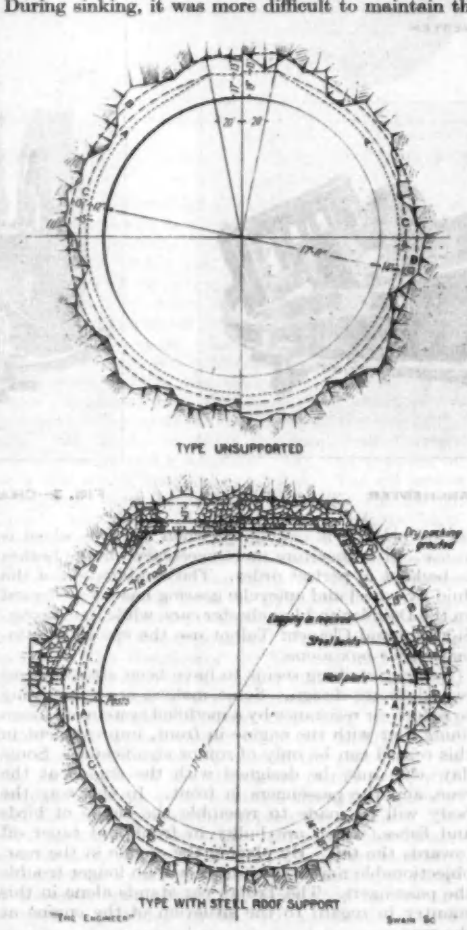


FIG. 8—TYPICAL SECTIONS OF TUNNEL NO. 2

alignment because there was no means of supporting the caisson by the rubbing blocks that served so well when sinking the smaller caissons. The deck was not constructed until the caisson was sunk as far as possible without the use of compressed air. At a depth of 21ft., it was found advisable to have recourse to air, and the deck was then built at a point about 25ft. above the cutting edge. Instead of relying on concrete reinforced as beams, as in the smaller caissons, the deck was designed to resist flexural stresses by four girder beams to which the loads were transmitted by reinforcement perpendicular to the beams. The concrete encasing this steel was 3ft. thick. When the caisson reached the ledge the method of sealing into the rock was as previously described, but the procedure was complicated by the larger number of reinforcing rods and by the fact that the transition between the circular and the elliptical sections started immediately below the caisson seat.

(To be continued.)

SIXTY YEARS AGO.

WE did not like the "Devastation," the latest addition to the British Navy, and in our issue of October 18th, 1872, we expressed our dislike of her in a leading article. Our antipathy to her did not spring from the fact that she had been designed by Mr. (Sir E. J.) Reed or that she carried her four 35-ton guns in a pair of turrets or even from the fact that her original freeboard, following the disaster to the "Captain," had been greatly increased by the addition of a species of superstructure built up of thin iron. We disliked her because she had no masts and no sails and because she was the first sea-going British battleship to depend entirely on her engines for her propulsion. It was perhaps a somewhat strange dislike for an engineer to express, but it was founded on an extensive knowledge of current marine engineering practice in the Navy. Bitter experience had shown that the large engines used in warships were peculiarly liable to breakdown, and we insisted that very considerable improvements were required before mastless ships could be regarded with complacency. It was not the first time that that contention had been advanced in our pages. Those who opposed our views placed their trust in twin screws and the high improbability of both engines breaking down simultaneously. It was a good argument, and in our own time we have seen much made of it in other directions; for example, in the case of multi-engined aircraft. It is quite possible to apply the mathematical theory of chance to the subject, but however favourable the result of such application may be, it expresses only a probability and not a certainty. Indeed, the only thing which is certain is that the improbable will occur and confound the theory. It did occur in the case of the "Devastation." On October 15th, 1872, she left Portsmouth harbour for a contractor's engine trial. The sea was quite smooth. Following the satisfactory completion of some turning trials at three-quarters' speed, orders were given to go on at full speed. Almost immediately the condenser of the port engine gave way, a crack opening in the discharge box of the circulating pump. The breakdown was thorough and complete and there was nothing for it but to stop the port engine and return to Portsmouth on the starboard engine. The incident seemed to justify the propriety of using twin screws. Unfortunately, self-satisfaction on that score was not of long duration. Within a quarter of an hour the starboard engine broke down in precisely the same manner as its fellow. Helpless as a log, the ship had to drop anchor until temporary repairs having been effected, she was enabled to limp into port the following day. Had the failure taken place on the day of battle it would, we wrote, have been little short of a national calamity. There was no guarantee that the condensers would not again fail or that the cylinders would not split or that some of the other mishaps to which engines in the Navy were subject would not happen. We held the incident to be a complete vindication of our reason for disliking the ship. Nevertheless, subsequent experience was to demonstrate that the mastless ship first in the Navy and then in the mercantile marine represented sound policy and in the demonstration of that fact the "Devastation" herself, in spite of her early misfortune, was to play an important part.

The Motor Car Show at Olympia.

No. I.

The annual exhibition of motor cars, motor boats, and accessories, promoted by the Society of Motor Manufacturers and Traders, Ltd., at Olympia, Kensington, was opened yesterday (Thursday), and will continue until Saturday, 22nd inst. Although the names of several well-known makers are absent from the catalogue, the display of vehicles as a whole will be found comparable with any previous Show. As is the case in other great industries, the tendency of the trade is towards the gradual elimination of the smaller firms by the mass production methods and selling organisations of a few large makers. Hence it is that three-fourths of the cars built in this country are turned out annually from some half a dozen factories. In spite of this, the catalogue contains the names of nearly fifty firms of car makers, including a few from France, Italy, Germany, Canada, and the United States, which serve to maintain the international character of the Show.

Compared with the other great industries, British motor car builders are in a very satisfactory position, judging from the report recently published by the Society of Motor Manufacturers and Traders. The total output of cars last year was 226,307 vehicles, a drop of some 12,500 only from the record output in 1929. The falling off was in the private car section, to which tooth gearing is subjected when changing from one speed to another. In many 1933 cars, however, the fluid fly-wheel and simplified gear controls will replace the standard clutch and gear-box hitherto accepted as inevitable. With such means at their disposal, the veriest novice will be able to drive with silence and smoothness and a considerable advance will be made towards the abolition of noise on our roads. The Daimler fluid fly-wheel which is now being adopted by several makers adapts itself well to the epicyclic gear-box, but it can also be applied to the orthodox gear-box if a free-wheel device is employed, so as to enable the gears to be changed without the declutching process. Instead of the epicyclic gear-box, many makers get over some of the troubles of gear crashing by providing constant-mesh gears for one or more of the indirect drives, in which cases the changes are effected by shifting dog clutches, while in the Maybach gear-box a dog clutch is used which is servo-operated by engine suction after pre-selection by the driver.

In America the orthodox gear-box is being retained, through the intervention of the free wheel, but British designers do not take kindly to this device, which undoubtedly enables silent changing of gears to be effected. The free wheel has also the advantage of permitting the car to "coast" on down gradients, with the minimum of trouble, and in this way effects economy in fuel, and the only objection to it appears to be that more work is put on the brakes, since engine braking is impossible when the free wheel is in use. It is therefore more necessary for the brakes to be kept in perfect order. The combination of the fluid fly-wheel and epicyclic gearing has been effected on the Daimler and Lanchester cars, while Armstrong-Siddeley and Clement Talbot use the epicyclic automatic gear-box alone.

Nothing striking seems to have been attempted as regards body design. Some makers are attempting to reduce air resistance by a modified system of stream lining, but with the engine in front, improvement in this regard can be only of minor significance. Some day cars may be designed with the engine at the rear, and the passengers in front. In this way the body will be made to resemble the shape of birds and fishes, which are bulky in front and taper off towards the tail. By placing the engine in the rear, objectionable noises and fumes will no longer trouble the passengers. The Trojan car stands alone in this country in regard to the situation of the engine at the rear.

Front wheel driven cars have not made much headway, and experience has demonstrated that any small advantage gained by this system is discounted by complications in the method of springing. No great steps to improve springing systems appear to have been taken. The present system of semi-elliptic springs and dampers leaves something to be desired. Large-section, low-pressure pneumatic tires and hydraulic shock absorbers are helping to prolong the existence of the existing system, but with the popular small four-seater cars such means as we have mentioned cannot keep pace with varying spring periodicities caused by the loading of the car. Some makers, among whom the Lancia firm takes a prominent position, discard the conventional rigid axles in favour of a system which enables one wheel of each pair to be displaced without regard to the other. This method has the advantage of reducing the unsprung weight, but if applied to all four wheels is inclined to cause instability in taking corners.

Although the small six-cylinder car is becoming increasingly popular, there are some firms with very long experience which are reverting to four-cylinder units for the lowest powers. Our own experience caused us to remark some years ago that there would probably be a reversion in this direction. Although the torque is not quite so even with the four cylinders, these are now so improved as regards balance and quietness that it is difficult to detect a four-cylinder car from one with the larger number of cylinders, and there is no doubt that for "getting away" quickly with a cold engine, a sturdily built "four" is far superior to the "six," while as regards petrol consumption the comparison is all in favour of the "four."

It would appear from the report of the Society of Motor Manufacturers that the change-over by most makers from magneto to coil and battery ignition has not effected much improvement as regards freedom from breakdown. According to the figures given for 1931, ignition apparatus is the most troublesome part of car mechanism, and the number of breakdowns due to it amounted to 20·8 per cent. This large percentage is, no doubt, due chiefly, but not entirely, to battery troubles, and might be reduced if motor car users paid more attention to these essential components which are too frequently stowed away in inaccessible places under the seats or floorboards. It should also be borne in mind by motor car users that the life of accumulators is limited to two or three years under the most favourable circumstances. It is, no doubt, asking too much from builders of the cheaper cars to provide some alternative ignition mechanism in case of failure of the battery, but in the case of the more luxurious vehicles a dual system of coil and magneto should always be supplied, or alternatively, some visible means might be provided for indicating the condition of the battery. An interesting development in this connection is the Vertex magneto, shown by Scintilla, Ltd., which is claimed to combine the advantages of both magneto and battery.

The motor boat section provides a good indication of the wide range of craft now available from boats 7ft. 6in. long and propelled by a tiny electric motor, to models of luxurious seagoing yachts, the propelling machinery of which ranges up to 400 horse-power. The outboard motor still holds its own in popularity, but small inboard engines are required for yacht's tenders and fast miniature launches.

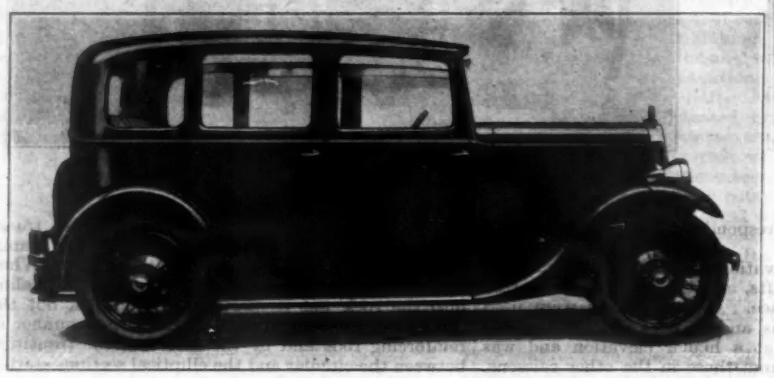


FIG. 1—10 H.P. SALOON—LANCHESTER

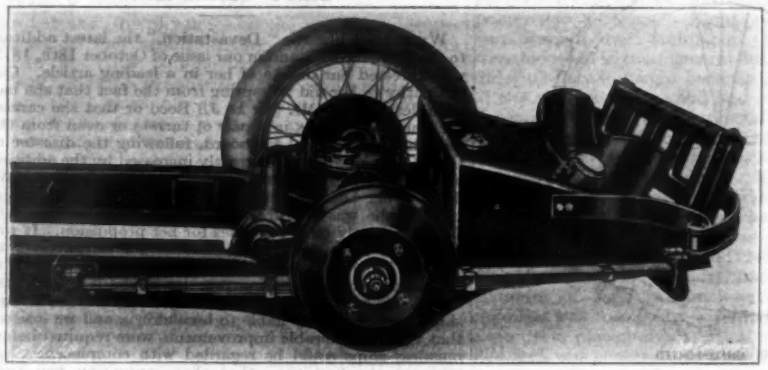


FIG. 2—UNDERSLUNG CHASSIS—LANCHESTER

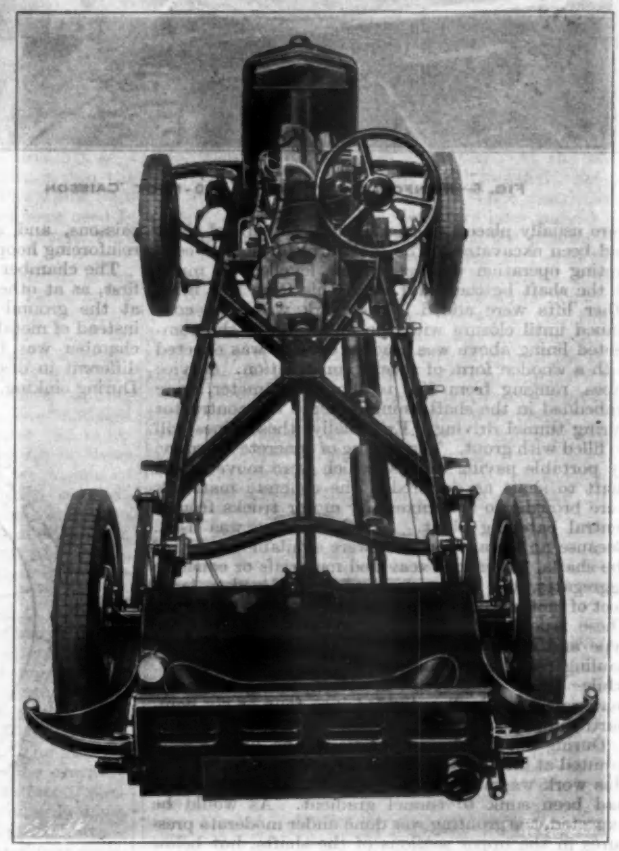


FIG. 3—CHASSIS WITH DAIMLER TRANSMISSION—LANCHESTER

LANCHESTER.

Amongst the new cars on view at Olympia one of the most attractive is the 10 horse-power Lanchester, several illustrations of which are given,

see Figs. 1 to 4. It constitutes a fresh departure by its makers who have hitherto not built cars of such small power. Its principal novel features are the Daimler fluid fly-wheel and epicyclic gear-box, which makes it an ideal vehicle for inexperienced drivers who are prepared to pay more for their pleasure than is needed with the average 10 horse-power cars. The car is, indeed, in the de Luxe class of small saloons capable of taking four persons in comfort. The body is carried on a chassis with a rigid low frame underslung below the rear axle. The power unit is a four-cylinder engine, 63·5 mm. bore by 95 mm. stroke, with a cubic capacity of 1203 c.c. and R.A.C. rating of 10 horse-power. It has overhead valves in line operated by silent push-rods, and is very similar in design to the 15–18 H.P. engine introduced by the makers recently. The cylinder block is cast in one piece with the upper part of the crank case, and the large diameter balanced crank shaft is carried in three bearings. The pistons are of aluminium alloy with split skirts. In a tunnel at the side of the crank case is the cam shaft, which is driven from the rear end of the crank shaft by a twin roller chain, which also operates the dynamo. The cams operate hollow tappets in detachable guides, and into the hollow tappets are dropped the lower ends of push-rods. At the top end of each of these rods is a ball socket, which engages with an adjustable ball head in the end of an overhead rocker for each valve. All the rockers are carried on a common shaft through

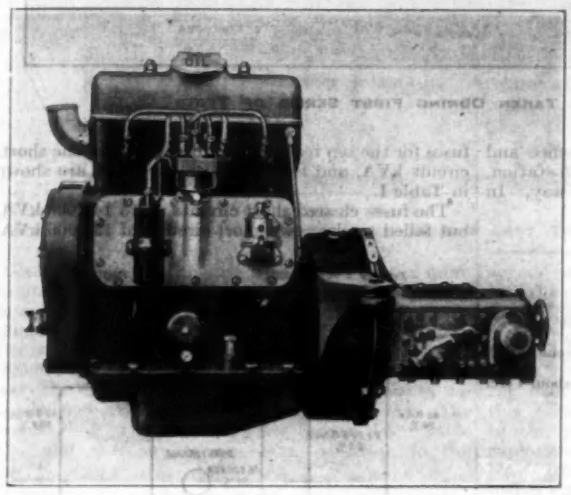


FIG. 4—10 H.P. ENGINE AND FLUID FLY-WHEEL—LANCHESTER

which lubricant is supplied to their bearings. Both the inlet and exhaust passages are cast integral with the cylinder head and are on the same side. An SW carburetter is used with the usual mixture control, and an air silencer. It is on the side of the engine above the dynamo. The dynamo has a spigot mounting to allow of adjustment of the driving chain. On the same side of the engine the starting motor is fitted, being spigoted into one of the arms of the bell housing round the fly-wheel.

The engine has forced lubrication right up to the gudgeon pins, and there is an electrically operated "tell-tale" to indicate when the oil requires replenishing. At the rear of the engine there is a housing which encloses the fluid fly-wheel and to this is bolted the casing of the four-speed, self-changing gear-box. This is of the epicyclic type, in which the gear trains are engaged by hand brakes. The engine and gear-box mounting is unusual. The attachment is made at four points to the frame, two being at the extremities of the bearer arms formed on the bell housing, while the other two are close together at the front of the engine on the front cross member. There is no metallic contact between the bearer arm and the frame, rubber cones being employed to intercept vibration. The radiator has a large header tank and the water is cooled on the thermo-syphon system. Lockheed hydraulic brakes are used, and the hand brake is on the right-hand side. It operates the shoes on the rear drums through a cross shaft and cables.

Ignition is by coil with automatic advance, and petrol from an 8-gallon tank at the rear is supplied to the carburetter by an A.C. pump. The final drive to the rear axle is by worm gearing. The springs are of the long semi-elliptic pattern, fitted with hydraulic shock absorbers. The wheel base is 8ft. 6½in., the track 4ft., and the length overall 12ft. 6in.

We have had an opportunity of driving this car and were agreeably impressed by its quietness, smoothness, flexibility and ease of control. It is impossible to crash the gears, which are pre-selected by a fitting on the driving wheel. The depression of a pedal which replaces the usual clutch pedal, and the opening of the accelerator puts the car into motion, and a repetition of these movements changes the gears up or down as required.

The allied Daimler and Lanchester firms have also on view a full range of their higher powered cars, including a Daimler double-six limousine, with a twelve-cylinder sleeve valve engine, with a Treasury rating of 49·4 horse-power, and fluid fly-wheel and self-changing gear-box, and a new departure in the form of a 15 horse-power car with poppet valve engine.

Morris.

Six models are shown by Morris Motors, Ltd., namely, the Morris Minor, the Morris-Cowley, Major, Morris Oxford, the Isis and a newcomer in the Morris 10 horse-power car with a four-cylinder engine having side-by-side valves and a four-speed gear-box, see Fig. 5. The latter has a twin top silent third gear, as is now almost general, and all the cars are fitted with a new flashing traffic direction indicator. This takes the form of a set of three coloured lights fitted on the scuttle on both sides of the car and readily visible both from the front and rear. The lights are controlled from a switch placed conveniently to the driver's hand on the dashboard. The engine of the new 10 horse-power car has a bore and stroke of 63·5 mm. and 102 mm., giving a cubic capacity of 1292 c.c. The four cylinders are cast *en bloc* with the skirt of the crank case which extends well below the crank shaft centre. The crank shaft has three bearings of large dimensions and the pistons are of aluminium of the four-ring type. The engine has side-by-side valves and the combustion spaces in the L type head are machined to ensure equality of compression and reduction of carbon deposits. The valves are operated by a cam shaft which runs in three bearings and is driven by a duplex roller chain from the crank shaft. The tappet guides are mounted in two units, which can be removed without interfering with any other component, and the tappets are spring loaded to ensure silence. The induction pipe and exhaust manifolds are cast integral and are provided with hot spots. An important feature of the induction system is a combined air preheating cover and cleaner, which also collects and consumes all fumes discharged from the crank case breathers. A spur gear pump mounted externally in the side of the crank case is driven from the cam shaft through helical gearing and a diagonal shaft, and supplies oil for a full forced feed oiling circuit. The oil passes through a filter before entering into circulation. Chassis lubrication is effected by an Enots high-pressure oil gun in conjunction with accessible nipples. The cooling water circulates from the base of the cylinder jackets upwards by thermo-syphon action. It is passed from the cylinder head through two ports which ensure even temperature distribution and absence of water pockets. The radiator is fan assisted. The distributor for the coil and battery ignition is driven from the upper end of the diagonal oil pump shaft and is easily accessible. The dynamo is readily detachable without disturbing the timing chain. The starter motor is of the sliding pinion type and is located on the side of the gear-box. An S.U. carburetter of the automatic piston type, with adequate control over mixture strength, operated from the steering column, supplies the mixture. The petrol tank is mounted at the rear of the chassis and has a capacity of 7 gallons. Its contents are indicated to the driver by an electrically operated dial gauge on the instrument panel. Gravity feed to the carburetter is provided by an S.U. automatic electric petrolift. A clutch of the single-plate type having cork inserts in the driven plate, automatically fed with oil from the crank case, ensures smoothness of action and requires the minimum of attention. All gears are of case-hardened nickel-chrome steel. Constant-mesh gears and third speed gears are of the double helical silent type. A balanced tubular propeller shaft transmits the drive to the spiral bevel final drive gears in the rear axle and is provided with universal joints of the fabric disc type with centring steadies.

(To be continued.)

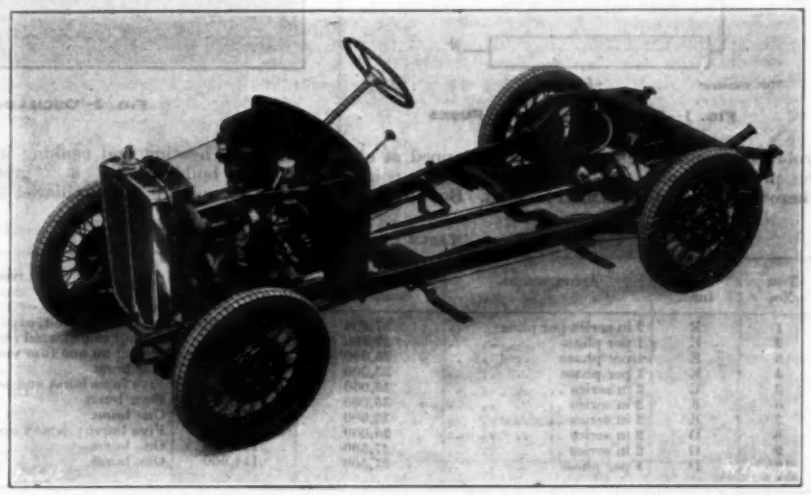


FIG. 5—10 H.P. CHASSIS—MORRIS

Electro-Farming.

For several years the British Electrical Development Association has held a conference at the Royal Agricultural Show with the object of impressing upon farmers the economic advantages of the application of electricity to all operations on the farm. It is recognised, however, that these conferences do not appear to reach the farming community as effectively as they should do and that greater co-operation is necessary between the supply authorities dealing with rural areas and the farmers. It was therefore for the purpose of discussing the more technical details of the subject with the farming interests, and also with the supply and manufacturing side, that a one-day electro-farming conference was held at the Greater Felcourt, East Grinstead, all-electric farm of Mr. R. Borlase Matthews, on Saturday, October 8th.

The matter was discussed from two angles, viz., (1) what was referred to as the "bread and butter" electrical equipment which the farmer will install when he first uses electricity, and (2) the larger electro-farming equipment, such as the 150 H.P. hay drying and disintegrating plants, the 250 H.P. electric plough, the 30 H.P. rain cannons which are being used on the Continent, electric soil heating, &c. The conference was opened by the display of a number of films of electro-farming operations on the Continent and in this country, with a general description of the types of apparatus and their applications. Whilst it was the general view that there should be individual motor drive for each separate piece of farming apparatus, it is realised that in order to induce the farmer in this country to take up electricity for many other purposes than electric lighting it will be necessary at first merely to change from oil or other form of power to electricity for driving a countershaft to operate a number of machines. There is still a great hesitancy on the part of farmers to make even this change, and it was something of a surprise, after extensive propaganda on the subject, to hear a representative of one county agricultural authority say that he was at a loss what to reply to the farmer who inquired as to whether it would pay him to adopt electricity. Certain figures were therefore given during the discussion indicating how the adoption of the individual motor drive not only makes savings which pay for the cost of the apparatus, but also enables still further savings to be made which render the operation more economical from every point of view.

Among the technical points that were raised was the applicability of the motors now made by British makers to farming operations. It was contended by Mr. Borlase Matthews that none of the three-phase squirrel-cage motors, for example, turned out by British firms are really suitable for farming work. The conditions laid down were that such motors should be capable of being left out in all weathers with no more covering, perhaps, than an artificial manure sack, that they should be fool-proof, capable of operating safely in an explosive atmosphere, and so on. The reply of the manufacturers, it was alleged, had been that they could not modify their standard lines for the sake of a few farmers, and that in any case these standard motors did farming operations quite satisfactorily. Against this attitude was mentioned what has happened on the Continent. There, as the result of concentration upon the requirements of the farm, the large electrical manufacturing firms are turning out as much as 80 per cent. of their motors specially designed for agricultural operations.

The other technical problem which received discussion was whether supply to farms should be on the single-phase or three-phase system. Mr. Borlase Matthews favours the three-phase system for various reasons, chief among which is the very much lower cost of the three-phase squirrel-cage motor. There are, however, advocates of the single-phase system, their view being that a single-phase line is cheaper to install and that when the complete motor equipment is taken into account there is not very much difference between the cost of a single-phase and a three-phase motor. The portable electric motor was not very much favoured.

The Mond nickel works at Clydach, Swansea, are to restart, and by November approximately 350 men will be back at work—about half the usual complement. The works ceased operations a month ago to work off an accumulation of stocks and to install more modern machinery.

Short Circuit Tests on 132-kV Fuses.

When the national power scheme was first proposed and critics began to look for weak points in the idea, many engineers expressed the view that it would be impracticable to take tappings from the "grid" lines for the purpose of small power supplies. The high cost of the switchgear necessary to cope with fault conditions, they explained, would be altogether prohibitive, and if "grid" lines were tapped at all, the practice would only be permissible at points where there was a big demand for load. But recently, small non-resonating transformers connected to the 132-kV lines without any primary protection at all, it has been possible to provide the entire power supply for lighting, heating and cooking in the office and associated buildings of a "grid" sub-station, and also to operate the auxiliaries in this way. In utterances on the part of the Central Electricity Board have indicated that this problem of taking small supplies from the 132 kV lines has been receiving attention, and that a certain amount of practical work of this nature has been done. Our readers do not need reminding that by means of view of these results, we have suggested that it might, in certain cases, be possible to give isolated communities supplies and so relieve some people of the annoying experience of having "grid" lines in their immediate vicinity without the least prospect of getting a supply. However, since the publication of the Central Board's third annual report, we have heard nothing more from this source about tapping "grid" lines for small supplies with the aid of small transformers and other special devices.

That the problem is not being neglected, however, is evident from the fact that Mr. J. M. Kennedy, of Kennedy and Donkin, has recently made arrangements with the Central Electricity Board for a series of tests on high rupturing capacity fuses. The first tests were made at the Kirkcaldy sub-station of the Scottish "grid," where sufficient power was obtained for the purpose by coupling up power stations in the area. Chemical extinguisher type fuses, consisting of glass tubes of suitable length with metal ferrules and spring operation to ensure an adequate gap in the extinguishing liquid after the fuses had blown, were chosen. They were "Empire" fuses of American design, and were made by Electric Control, Ltd. The tests were begun with short circuits of about 85,000 kVA, and were carried up to rather more than 170,000. In some cases two fuses were connected in series in each phase, as shown at *a* in Fig. 1, whilst in other cases one fuse was used per phase, as shown at *b*. The arrangement of the fuses for the ten tests, the connected plant, the short-circuit kVA, and the effects on the fuses, are shown in Table I.

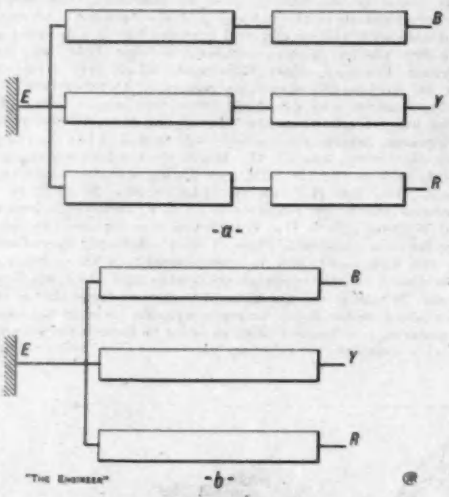


Fig. 1—Arrangement of Fuses

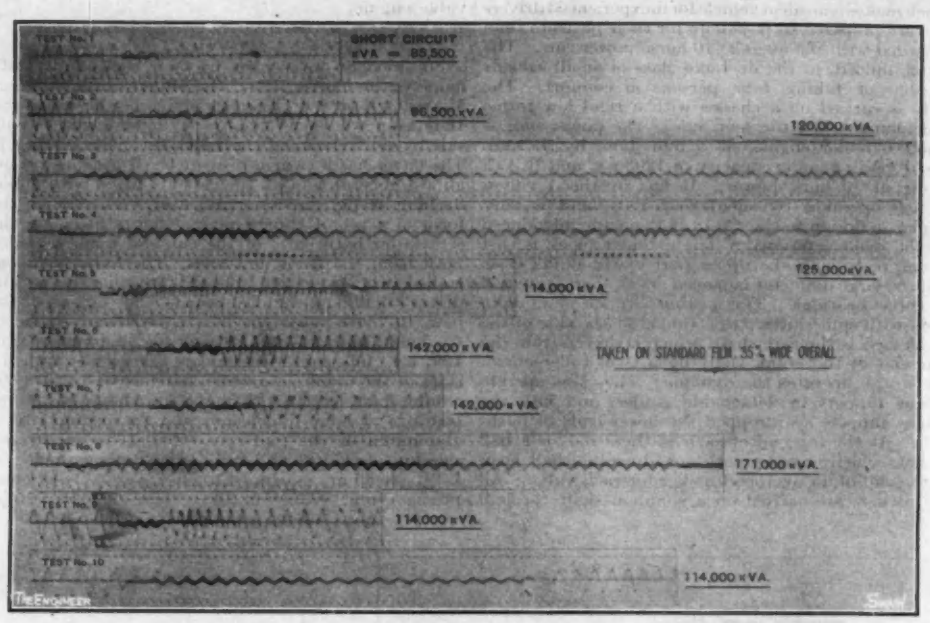


Fig. 3—Oscillograms Taken During First Series of Tests

Table I.—*First Series of Tests.*

Test No.	Type fuse.	Arrangement.	Plant connected.	S C kVA.	Test results.
1	E	2 in series per phase ..	27,500	85,500	All fuses cleared, caps blew out
2	E	1 per phase	27,500	96,500	All but one cleared (one burst)
3	E	1 per phase	35,000	120,000	Arcing on one fuse very hard (one burst)
4	E	1 per phase	35,000	125,000	One burst
5	E	2 in series	35,000	114,000	Five fuses burst and arced for about 1 sec.
6	E	2 in series	35,000	142,000	Four burst
7	E	2 in series	35,000	142,000	One burst
8	D	2 in series	35,000	171,000	Five burst; heavy arcing
9	D	2 in series	27,500	114,000	One burst
10	D	1 per phase	27,500	114,000	One burst

Fig. 2—Test with "Empire" Fuse

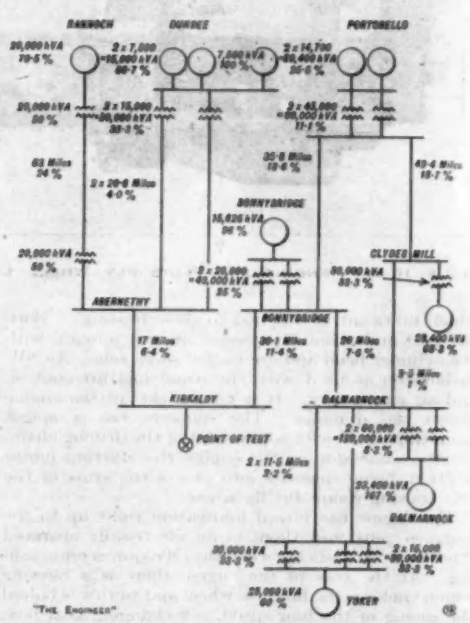


Fig. 4—Power Station Connections.

The fuses cleared short circuits up to 142,000 kVA, but failed to clear two short circuits of 120,000 kVA. At 170,000 kVA the fuses failed to clear and the short circuit was dealt with by the oil circuit breaker. The fuses which cleared successfully opened in from 4–8 cycles. The oscillograms of the ten tests (Fig. 3) indicate that in some cases the operation of the fuses left much to be desired, whilst the picture,

Table II.—*Short-circuit Tests on 132,000 Volts, carried out at Kirkcaldy, Sunday, April 17th, 1932.*

Order of test.	Time of test.	Test No. (from Schedule).	Design No.	Fuses in series.	Plant capacity	Fuses cleared circuit.	No. of fuses broken.	Liquid.		O.C.B. tripped on.		Duration of S/C in				R.M.S. value of highest current in red or blue phase.	Value of s/c, 3-phase, calculated from figure in previous column
								Quantity spilt.	Colour.	O/L.	E.L.	Red phase.		Blue phase.			
	a.m.				kVA.							Cycles.	Secs.	Cycles.	Secs.	Amps.	kVA.
A	9.43	13	5	2 (66 kV)	27,500	Yes	None	None	Sl. dark	No	No	0·53	0·0106	0·825	0·0165	918	210,000*
B	10.40	14	5	2 (66 kV)	42,200	Yes	None	None	Sl. dark	No	No	0·77	0·0154	0·77	0·0154	1,360	310,500*
C	10.55	15	5	2 (66 kV)	42,200	Yes	None	Slight	2 phases black, 1 sl. black	No	No	1·25	0·025	1·125	0·0225	1,690	386,000
D	11.15	16	5	2 (66 kV)	42,200	Yes	One	None	Moderately black	No	No	1·5	0·030	1·055	0·0211	1,275	291,000†
E	11.35	17	6	2 (66 kV)	64,400	Yes	None	Slight	One phase sl. more black than other two	No	No	0·97	0·0194	1·485	0·0297	2,087	476,500
	p.m.																
F	12.45	18	6	2 (66 kV)	71,900	Yes	None	Slight on phase where blackened	Sl. dark	No	No	0·965	0·0193	1·895	0·0379	2,406	549,000
G	1.20	5	3	1 (132 kV)	71,900	Yes	One	Very slight	Mod. black	No	Yes	11·35	0·227	0·855	0·0171	1,933	441,000‡
H	2.40	9	4	1 (132 kV)	71,900	Yes	None	Very slight	Sl. dark	No	No	0·91	0·0182	1·055	0·0211	2,185	498,000
J	4.05	10	4	1 (132 kV)	95,300	Yes	None	Very slight	Sl. dark	No	No	0·8	0·016	1·065	0·0213	3,167	723,000§
K	4.40	11	4	1 (132 kV)	159,325	Yes	None	Approx. 10%	Very dark	No	No	1·61	0·0323	1·47	0·0294	4,070	931,000
L	5.05	19	6	2 (66 kV)	159,325	Yes	None	Approx. 10%	Fairly black	No	Yes	1·46	0·0292	1·155	0·0231	3,555	812,000‖
M	5.35	20	6	2 (66 kV)	159,325	Yes	None	10% in one phase, Very slight in others	Black	No	No	1·065	0·0213	2·02	0·0404	4,345	992,000

Remarks.—* Colour of liquid uneven, darker in one phase than in another. † Experimental potential transformer fuse. Mechanical fault in fuse trip mechanism in one fuse caused breakage. ‡ Experimental type. Vent insufficient, O.C.B. tripped after fuses had cleared. (C.E.B. report). § One porcelain liner cracked. ‖ Three porcelain liners cracked, O.C.B. tripped after fuses had cleared (C.E.B. report).

Fig. 2, which is from a film taken during these tests, shows that in some cases the operation of these fuses led to a fair amount of arcing.

At the works of Allen West and Co., Ltd., of Brighton, we recently saw the complete film of this series of tests, and a second film of another series of tests made with other fuses. The improved performance in the latter case was very marked. As the result of the experience gained from the first ten tests referred to in Table I., it was decided by

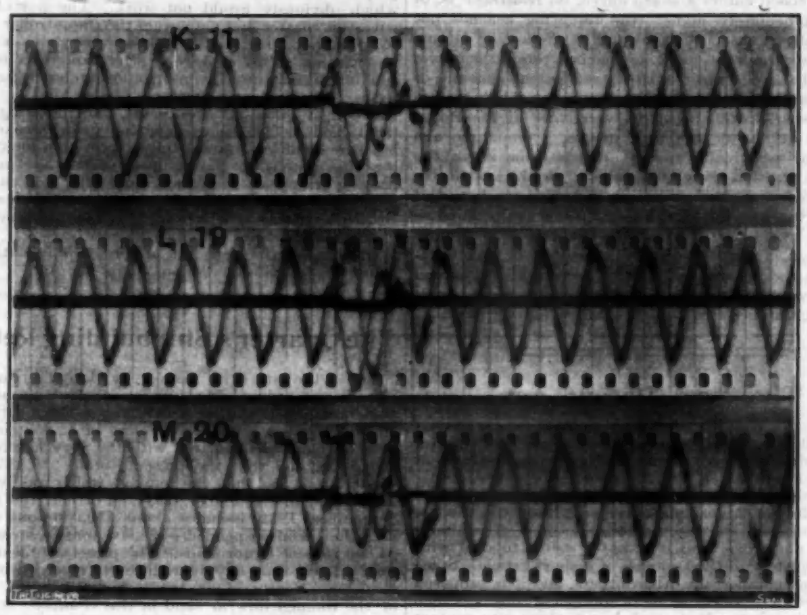


FIG. 5—OSCILLOGRAMS RELATING TO THE LAST THREE TESTS IN SECOND SERIES

Allen West and Co. to design new fuses with a minimum capacity of 1,000,000 kVA, and some months later the second series of tests, to which we have alluded, was carried out at Kirkcaldy by the Central Electricity Board. Short circuits up to 992,000 kVA were cleared successfully in times varying from 1–2 cycles, and short circuits up to 300,000 kVA in three-quarters of a cycle. The results of these tests are given in Table II., and the oscillograms—Fig. 5—relate to the

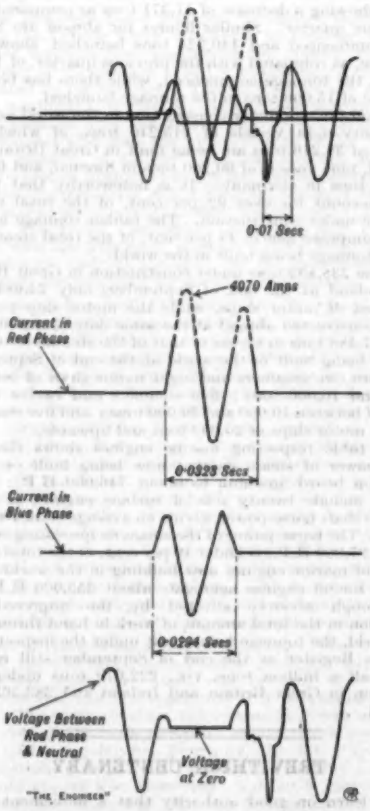


FIG. 6—ANALYSIS OF OSCILLOGRAM K 11

three last tests in that table. The oscillograph record of the 132 kV fuses on test K 11 calls for explanation. It will be noted that a three-element oscillograph was used with two current elements and one voltage element. The ideal would, of course, have been to have had six-element oscillographs with three voltage and three current recorders; but, unfortunately, apparatus of this nature was not available. The phases which had most of the rupturing were the red and yellow phases. The liquid was very dark in the red phase fuse, and the current was so high that it exceeded the range of the film. The curve has, therefore, been carefully extrapolated in Fig. 6, assuming a sine wave form, and the current of 4070 ampères is approximately correct.

Power was not available for heavier short-circuit tests, but it was obvious that the fuses tested were well able to grapple with the loads applied to them. The general principle of the fuses is well known. There is a short fuse element under tension from a spring, and when the fuse blows the arc is drawn into the extinguishing liquid and the circuit is opened very rapidly. One of the novel features of the type of fuse that gave the best results, *i.e.*, type "H.R.I," is a comparatively thin glass vent which fractures and relieves the pressure on the main tube under short-circuit conditions. In this horizontal fuse this vent is at right angles to the path of the arc and is mounted in an explosion chamber in the centre of the fuse. The blast from the extinguishing liquid and vapour rushes through the vent at right angles to the path of the arc. In the case of the two 66,000-volt fuses connected in series for the test M 20 the glass vent was at the end of the fuse and not at right angles to the arc. These fuses cleared quite satisfactorily, but with much more noise and with less margin of

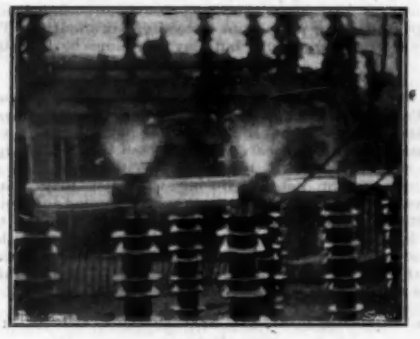


FIG. 7—TEST WITH IMPROVED FUSE

breaking capacity than the fuses with the gas blast at right angles to the arc.

The object of the tests was to determine the suitability of the fuse to deal with short-circuit conditions on the 132,000-volt lines. This is claimed to have been amply proved, and whatever power was applied as the tests progressed the fuses cleared the short circuits in about 1 cycle, and the generating station observations did not reveal any severe disturbances during any of the tests. Even when the Scottish system was paralleled up, as shown in Fig. 4, there were no reports of any dislocation of the supply on the general system. The conclusions that have been drawn are that under certain conditions these new fuses can provide an inexpensive means of tapping high-tension lines at points where the cost of installing high rupturing capacity circuit breakers is prohibitive. The new fuses are applicable to all voltages where specially high rupturing capacity is required, but they are not intended to supersede the "Empire" type of fuse, which forms a less costly alternative for ordinary conditions. The illustration Fig. 7 is from a film taken during the second series of tests. It shows the improved fuses in action, and it will be perceived that the local disturbance is not to be compared with that shown in Fig. 2.

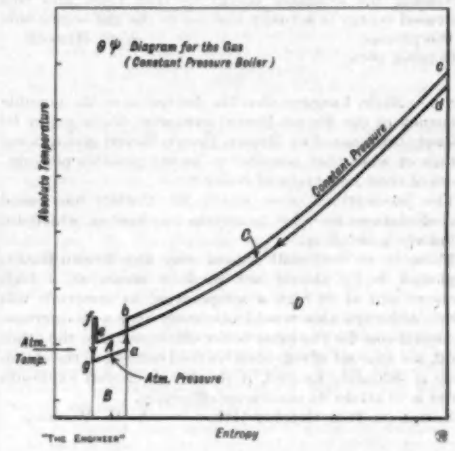
Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

OVER 100 PER CENT. EFFICIENCY.

SIR,—The features and possibilities of the Brown Boveri Velox boiler can, perhaps, best be seen by studying the temperature entropy diagram for the gases. As regards the "explosion" type, however, there is the difficulty that all portions of the gas do not follow the same cycle. The first portions of the gas leaving the combustion chamber have a different history from that of the later portions. In the "constant pressure" type of boiler every part of the gas follows the same cycle, and the $\theta\varphi$ diagram for the gas may be drawn. Brown Boveri state that in this design it is necessary to provide boiler heating surface after the turbine as well as before it, as if the turbine is placed at the end of the surface, the turbine work in practice would not exceed the compressor work. In the accompanying $\theta\varphi$ diagram, however, the turbine is placed in the final position, as in the "explosion" type, and it would appear from the diagram that even with the turbine so placed the efficiency of the boiler may theoretically exceed 100 per cent., and at the same time the turbine give sufficient power to drive the compressor. In practice, with the turbine in the final position, this result is probably unattainable, due to losses, but the "theoretical" possibility is sufficient to settle the question raised in this discussion as regards both types of boiler.

In the figure *a b c d e f g* is the ideal $\theta\varphi$ diagram for



the gases in the "constant pressure" boiler as modified by placing the turbine at the end of the heating surface. Neglecting the superheater we have:

a b, adiabatic compression in the compressor.
b c, heat of combustion received at constant pressure.
c d, adiabatic expansion at entrance to tubes giving kinetic energy to the gases.
d e, heat rejected to water. Pressure probably falls somewhat; *e* may be to the left of *a b* while still keeping the temperature above that of the water and the pressure above atmospheric.
e f, adiabatic compression by conversion of kinetic energy into pressure energy in a diverging tube (or the kinetic energy may be absorbed by adding velocity wheels to the turbine).
f g, adiabatic expansion in the turbine down to atmospheric pressure and below atmospheric temperature.

Ideally, all these processes are reversible and all friction through valves and tubes is neglected. (We are not here concerned with the irreversible heat transfer from the gas to the water.) The gas cycle being reversible, the area of the $\theta\varphi$ diagram represents net external work done by the gases. The area is $+C-A$ and the net work is the turbine work minus the compressor work; hence, for the turbine to drive the compressor the condition is that $C =$ or $> A$.

The question is: Can the turbine drive the compressor and at the same time can the heat efficiency be greater than 100 per cent.? In the first place, we see that, regarding points *a b c g* as fixed, it is possible to adjust the pressure corresponding to point *d* so that area C = area A, *i.e.*, turbine just drives compressor. Secondly, heat to boiler = area under $d\,e = A+B+D$, and heat of combustion = area under $b\,c = C+D$. Therefore, efficiency $= \frac{A+B+D}{C+D}$. If the turbine just drives the compressor $A = C$, and efficiency $= \frac{C+B+D}{C+D} = 1+\frac{B}{C+D}$. This efficiency exceeds 1 if $B > 0$, *i.e.*, if point *e* is to the left of the adiabatic *a b*. If, now, the curve *d e* is dropped slightly, forming new areas $A^1\,B\,C^1\,D^1$, C^1 will exceed A^1, *i.e.* there will be a surplus of work from the turbine C^1-A^1. The heat efficiency is now $\frac{A^1+B+D^1}{C^1+D^1}$ $= \frac{A^1+B+D^1}{C+D}$, which is less than when $C = A$; but we may now add the excess work to the heat given to the boiler, which then becomes $A^1+B+D^1+C^1-A^1 = C+B$

+D as before, and heat of combustion is still C+D; therefore efficiency is unchanged. We thus see that there is a margin to take care of practical losses.

In the case of perfect gases expanding adiabatically, drop of temperature is proportional to drop of heat content, and the latter = work done; hence, for turbine work to exceed compressor work $f g > a b$.

The advantage of this cycle over that of ordinary boilers is a real one, as it gives to the boiler more heat than is contained in the fuel without sacrificing any of the steam engine efficiency and requiring only a limited heating surface. The apparent paradox is explained if we remember that the law of the conservation of energy does not prevent us by means of a heat pump from increasing the heat in a body by adding to it heat taken from the atmosphere, as is done in this case and in the Kelvin heating apparatus. There is, however, a conservation of the available energy theoretically obtainable from the total heat so produced. In all actual boilers, however, including the Velox, there is a great loss of available energy in the transfer of heat from the high-temperature gas to the moderate-temperature water and steam. If, therefore, by means of heat pump action we produce a greater amount of heat than in the fuel, and if the temperature of this heat, though reduced, is still above the temperature of the water, then, as in this boiler, we increase the available energy of the steam, and reduce the loss of available energy in the irreversible process of heat transfer.

There is a further thermodynamic gain, however, in the use of the compressor and turbine, due to the fact that the heating of the gases in the compressor causes the heat of combustion to be received by the gas at a higher temperature than when not compressed, thereby increasing the available energy of that heat, and this increased energy is actually realised in the gas engine side of the process.

A. G. Hinton.

October 10th.

Sir,—Might I suggest that the discussion on the possible efficiency of the Brown-Boveri explosion boiler might be fittingly terminated by Messrs. Brown-Boveri giving some details of what they consider to be the possible performances of their new types of boiler?

The assumptions upon which Mr. Corbitt has based his calculations have led to certain conclusions, which are definitely misleading.

There is no technical reason why the Brown-Boveri explosion boiler should not produce steam at a high pressure and at as high a temperature as materials will allow, although this would obviously cause an increase in capital cost for the same boiler efficiency. On the other hand, the amount of regenerative feed heating in the steam cycle is definitely limited, if the Brown-Boveri explosion boiler is to attain its maximum efficiency.

Norton-on-Tees, October 11th. A. H. Waring.

RAILWAY TRACTION.

Sir,—The candid opinion so ably expressed in your leading article in The Engineer of September 16th last has, I feel sure, been appreciated in many directions in the locomotive engineering profession.

One thing, however, which has been lacking in most of the technical papers on "Railway Traction" and that is, Which is the most suitable method of railway traction, namely, whether "locomotives" should be exclusively used or whether the "multi unit" method of traction should still be tolerated?

A locomotive is a practical and compact self-contained piece of mechanism, with perhaps two, three, or four efficient driving axles; the whole of the mechaniam is under the eye of the driver and has no outside connecting links liable to fail. Apart from the obvious characteristics proper to an independent traction unit, there is the question of wheel and track wear and tear. This wear on the few large driving wheels of a locomotive is not nearly so serious as the greater amount which takes place on the smaller driving wheels of a "multi-unit" job, with which experience indicates enormous cost of track construction, short life, and costly renewals.

In locomotive traction the whole machine is easily detached from the train at any time, whilst in the case of "multi-unit" traction, if something goes wrong with a motor the whole train has to be brought to the inspection pits and then probably broken up or a new coach inserted. Hence the interchangeability of coaches on a multi-unit system is not just the same thing as simply changing a locomotive. Quite apart from the trouble and time taken in the coach-changing process, the apple cart can be very quickly upset on the "electrical" side of the matter. For instance, when a multi-unit train has been in service for a given period, none of the wheel diameters are any more equal, the gear ratios remain the same, of course, but the proper working of the electric motors is upset and they will no more pull equally; in fact, they become both electro-magnetically and mechanically out of balance, and it may well be that out of, say, eight motors on the train perhaps three are doing the majority of the work, while the others are simply hangers-on or contributing far from their fair share of work. The three thus "overloaded" machines become, of course, overheated, while the hangers-on remain nice and cool. This, what I will term local motor overheating (by variable wheel diameters, &c.), is mostly the cause of serious sparking, burning, and sometimes terrible flashing-over in the poor thus overloaded motors. The unsatisfactory operation of the multi-unit system and the overheating of the multitude of motors was the cause of the Valtellina three-phase electric railway being changed to locomotive haulage some years ago, and Continental and American railway engineers are now generally agreed on the matter of the exclusive use of locomotives, especially for fast passenger and freight train services.

Most steam locomotive engineers are well aware that it takes much more tractive effort to "push" a train round a curve than to haul it round with the locomotive in front, and here lies the root of quite a lot of trouble in multi-unit operation. Even allowing that a multi-unit train is brand new, the wheels all the same exact diameter, and the electric motors all nicely balanced up, even then, when the front coach enters a sharp curve, its resistance is, of course, immediately higher (the following coaches not having entered the curve yet) and the following motors simply bunk the front coach, or coaches, round the curve, accompanied, of course, with a tremendous amount of wheel flange and rail wear and sometimes a whole stream of lively sparks. Thanks to the courtesy of the Royal Engineers at one of the Gun depôts, I sometime ago made some practical research investigations as to the increase in traction energy demanded from the locomotive when pulling and pushing a train of loaded trucks round severe curves, and the extra energy used when pushing as compared with that used when hauling was simply astounding, as very accurately measured by my watt-meters on the locomotive, jointly with an electric speed indicator very accurately calibrated.

London, October 4th. William P. Durtnall.

The New Patent Act.

The following useful summary of the new Patent Act has been circulated by Bertram T. King, registered patent agent, of 146A, Queen Victoria-street:—

The Patents and Designs Act, 1932, which comes into force on November 1st, effects certain changes in the law relating to inventions and industrial designs. The alterations are numerous, and it is not possible to deal with them completely in the compass of a short article. Some are of greater importance than others, and it is proposed to consider those likely to be of interest to business men and manufacturers whose work brings them into contact with novel developments in commerce and industry.

Provisional Protection.

The period of provisional protection under the new Act is extended by three months, so that the complete specification may now be left at any time within twelve months from the date of the application.

This period is the same as that allowed in which to file applications abroad under the International and Intercolonial Arrangements, so that if the complete specification is not left until the end of the period allowed, and if foreign patents are contemplated, then the foreign applications will have to be despatched before the complete specification is on the file in this country. Further, unless the complete specification following the provisional application is left well before the expiration of the twelve months, the search on novelty made by the Patent Office, the result of which very often influences the applicant's decision with regard to foreign patents, will not be available.

An applicant may now request the Comptroller to treat a complete specification filed with the application as though it were a provisional one, or may ask that an application for a patent be post-dated, any time before acceptance, for a period not exceeding six months. The latter is a risky procedure, but may sometimes be desirable.

Search on Novelty.

A very important change concerns the search made by Patent Office officials to determine to some degree whether an invention sought to be patented is novel. Formerly the official search was directed to the investigation of previous British patent specifications filed on applications for patents during the past fifty years. Under the new Act the search may be extended to foreign specifications and other documents. The widening of the search brings the English practice more into line with that prevailing in Germany and the United States of America, but the fact that a patent is granted is still no guarantee of its validity.

Acceptance of Complete Specification and Sealing of a Patent.

It is anticipated that greater work will be involved in carrying out the more extensive search directed by the new Act, and the time for obtaining acceptance of the complete specification has been extended to eighteen months from the application date. The Government fees on filing a complete specification have also been increased.

The time in which a patent must be sealed has been extended from eighteen to twenty-one months, so that under the new Act, the maximum time within which the patent must be sealed, including extensions of time which are obtainable (as under the principal Act) is twenty-eight months.

Further, this period may be extended by such an amount as appears to the Comptroller to be necessary, if it is proved that hardship would arise in connection with a patent application outside the United Kingdom. This applies particularly in the case of an application for a patent in the United States of America filed after twelve months from the application date in this country, as the American patent must issue—*i.e.*, be granted—before any patent for the same invention in any country.

Revocation and Infringement of a Patent.

Many new grounds upon which application may be made by petition to the court for revocation of a patent have been added. Formerly, if in an action for infringement of a patent it was found that some claims of the specification were valid and that others were invalid, the court was directed to grant relief in respect of the valid claims without regard to the invalid ones. By the new Act the patentee has to furnish proof that invalid claims were framed in good faith and with reasonable skill and knowledge if he wishes the court to grant relief in respect of valid claims without regard to invalid ones. If the patentee does not furnish such proof, the court will not grant any relief by way of damages or costs, but may grant other relief, such as an injunction in respect of any valid claim which is infringed. The above provisions make it more than ever necessary to exercise care and to obtain professional assistance in preparing a complete specification for letters patent.

Frivolous Applications.

During the past patents have been granted for so-called perpetual motion machines and such-like contrivances which obviously would not work. The new Act deals with this matter and empowers the Comptroller to refuse to grant a patent upon which he regards as a frivolous application. This is a wise alteration, because unfortunately ill-informed inventors and purchasers have sometimes wasted money on patents of this kind.

Amongst other changes made, the following may be mentioned:—Tightening up of the law in cases of groundless threats of legal proceedings; provision for the granting of a patent to the assignee of the applicant; the hearing of appeals from the Comptroller's decision by an appeal tribunal; and amendments in the law dealing with British applications which are based on applications filed in other countries.

In general, the new Act applies to applications filed before as well as after the passing of the Act.

The Quarter's Shipbuilding Returns.

From the statistics issued by Lloyd's Register of Shipping regarding vessels under construction at the end of September, it will be noted that in Great Britain and Ireland there is a further decrease of 42,259 tons in the work in hand as compared with the very low figures for last June, and that the present total—238,433 tons—is 178,952 tons less than the tonnage which was being built at the end of September, 1931. Further, the figure for September, 1932, includes about 150,000 tons on which work has been suspended—126,000 tons of steamers and 24,000 tons of motor ships. The present total of 238,433 tons is lower than any figure hitherto recorded by Lloyd's Register. Nearly 74,000 tons—representing 31 per cent. of the tonnage now in hand in this country—is intended for registration abroad or for sale.

The tonnage now under construction abroad—662,634 tons—is about 166,000 tons less than the work which was in hand at the end of June, 1932, and is the lowest recorded since the beginning of 1911. Tonnage, included in this figure, on which work has been suspended amounts only to 3680 tons of steamers and 19,232 tons of motor ships. The five leading countries are:—Italy, 127,969 tons; United States of America, 124,703 tons; France, 109,285 tons; Germany, 80,770 tons; and Sweden, 73,480 tons. The total tonnage under construction in the world amounts to 901,067 tons, of which 26½ per cent. is being built in Great Britain and Ireland and 73½ per cent. abroad.

In Great Britain and Ireland only 10,837 tons were commenced during the last three months—the lowest figures on record—and 47,884 tons were launched, this figure showing a decrease of 11,371 tons as compared with the June quarter. Similar figures for abroad are 32,572 tons commenced and 140,324 tons launched, showing a decrease, as compared with the previous quarter, of 10,000 tons in the tonnage commenced, while there has been an increase of 15,000 tons in the tonnage launched.

The oil tankers under construction in the world amount to twenty-eight vessels of 215,240 tons, of which five vessels of 38,216 tons are being built in Great Britain and Ireland, nine vessels of 60,200 tons in Sweden, and four of 49,600 tons in Germany. It is noteworthy that motor ships account for over 92 per cent. of the total tanker tonnage under construction. The tanker tonnage now in hand comprises nearly 24 per cent. of the total steam and motor tonnage being built in the world.

Of the 238,433 tons under construction in Great Britain and Ireland at the end of September, only 24,984 tons consisted of motor ships, while the motor ship tonnage being constructed abroad at the same date (385,060 tons) was 107,486 tons in excess of that of the steamers. Of the vessels being built in the world at the end of September, there are two steamers and eight motor ships of between 8000 and 10,000 tons; five steamers and twelve motor ships of between 10,000 and 20,000 tons; and five steamers and no motor ships of 20,000 tons and upwards.

The table respecting marine engines shows that the horse-power of steam engines now being built or being fitted on board amounts to about 746,000 H.P.; these figures include twenty sets of turbine engines of about 649,000 shaft horse-power, giving an average of 32,400 H.P. per set. The horse-power of the steam reciprocating engines (about 97,000 H.P.) is under 10 per cent. of the total horse-power of marine engines now building in the world. The figures for oil engines aggregate about 355,000 H.P.

Although severely affected by the unprecedented reduction in the total amount of work in hand throughout the world, the tonnage being built under the inspection of Lloyd's Register at the end of September still reaches over half a million tons, viz., 222,679 tons under construction in Great Britain and Ireland and 283,563 tons abroad.

TREVITHICK CENTENARY.

We learn on good authority that a movement is on foot among the engineering profession to mark in an appropriate manner the centenary in April next year of the death of Richard Trevithick, one of the greatest of our engineers. A meeting of representatives of engineering institutions has been called for Thursday, October 20th, at 5.30 p.m., at the Institution of Civil Engineers, Great George-street, Westminster, S.W.1, the Council of which has generously placed accommodation at disposal for the purpose. Engineers generally interested in the proposal are cordially invited to attend. The movement was started by the Newcomen Society for the Study of the History of Engineering and Technology, the hon. secretary of which is Mr. H. W. Dickinson, Barn Field, Riddlesdown-road, Purley, who will be pleased to answer inquiries.

Railway and Road Matters.

The L.M.S. is making experiments both in England and Scotland with vehicles equipped to spray weed-killer over the tracks as they go along. The weed-killer train consists of an engine, a brake van and a wagon fitted with a large tank and a spray-pipe controlled by a man riding on the wagon.

The late Sir Herbert Jekyll succeeded, in 1901, Mr. F. J. S. Hopwood as Assistant Secretary, Railway Department, at the Board of Trade, and when the London Traffic Branch was formed in 1907 he was made its chief and remained there until he retired, on reaching the age limit, at the end of 1911.

Speaking of a man who was killed in walking home through some sidings instead of by a quite convenient public road, Mr. J. L. M. Moore said in a recent report: "It is almost incredible that men should take such risks, but this regrettable occurrence brings to light the fact that some have done so in the past in spite of warnings and rules to the contrary."

Following our note of August 5th, we can now announce that after negotiations lasting twelve years, four trunk-line railway systems in the eastern part of the United States have been merged into one system valued at 8,000,000,000 dollars (£1,600,000,000 at par). The railways are: The New York Central, the Pennsylvania, the Baltimore and Ohio, and the Chesapeake and Ohio.

A letter in *The Times* of October 6th suggests that railways could find a source of economy in omitting the lettering "Railway" from their carriages, *e.g.*, "Southern," instead of "Southern Railway." We may point out in this connection, that Section 121 of the Railway Clauses Act, 1845, requires the owner's name to be painted in legible characters on some conspicuous part of the outside of every such carriage so as to be always open to view."

A mobile fleet of thirty "warehouses on wheels," for providing emergency or temporary warehouse accommodation at outlying stations, where there is no warehouse or where the existing accommodation is fully occupied, has been introduced by the L.M.S. Railway in several important areas, including North Wales, Leicester, Bristol, Northampton, and Stoke-on-Trent. These mobile warehouses are converted parcels brake vans or passenger vehicles, and are placed in wayside goods yards with a railway siding adjacent, so that freight can be unloaded direct from the wagons.

The census of railway servants as on March 12th last, shows that there were 597,971 employed as compared with 615,592 in March, 1931, a decrease of 17,621. The L.M. and S. had, roughly, 7000 less, the L. and N.E. 6000, the Great Western 4000 and the Southern 300. On all the railways there were 1330 fewer drivers and 1342 less firemen, but as an increase of 1099 is recorded in engine cleaners it would seem that many drivers now rank as firemen and firemen as put back to the cleaners' grade. There are 1776 fewer permanent way men and 3300 less shop and artisan staff.

The proposals for a National Transport Board came before the Labour Party Conference on October 5th, and call for mention here because of the opinion expressed by many of the speakers that the trades unions should be consulted by the Minister of Transport before any appointment was made to the Board. Among those who supported the contention that the membership should be left with the Minister and that the appointments be on "appropriate grounds of ability," was Mr. Herbert Morrison, the Minister of Transport in the last Labour Government, and the representative of the National Union of Railwaymen and of the Railway Clerks' Association. The Associated Society of Locomotive Engineers and Firemen, along with the Transport Workers' Union, supported the amendment, and, in the end, the Conference executive withdrew the proposals for further consideration.

In connection with the extension of the Southern Company's electrification southwards from Coulsdon to Brighton and Worthing, automatic signals, of the colour-light type, were brought into use between Coulsdon and Balcombe Tunnel on June 5th, and thence to Haywards Heath a week later. The signalling has since been extended to Preston Park, and that section was opened on October 7th. Brighton Station itself is being opened on Sunday next, the 16th. The six signal-boxes there will be replaced by one central signal-cabin, which will contain a locking frame of 225 levers, the interlocking of which will be effected electrically, instead of, as for the last ninety years, mechanically. The frame is being built by the Westinghouse Brake and Saxby Signal Company, and will have the unusual feature of being in three sections—a central and two side sections; the latter are at an angle of 120 deg. to the centre section. This arrangement will give the signalmen a greater command of the station and is only possible by the interlocking being actuated electrically.

Part of the new signalling at the King's Cross terminus of the London and North-Eastern Railway, referred to herein on September 16th, was brought into use on October 2nd, and the remainder will be opened on the 30th. The work done on the former date was attended with very unfortunate delays to trains, which conditions were still being felt on Thursday, the 6th. From the explanations given to the Press by the railway company it would appear that there was no delay in carrying out the vast alteration, but that the disorganisation mainly was due to a too fine adjustment of some of the electrical gear and to the method employed for working those connections which have one set of points in one line and another set in a second line, and where both work together by one lever. There is an electric motor at each set of points; these usually work in series, but at King's Cross they were made to work in parallel, and, unfortunately, uniform operation did not follow. The inconvenience to the public was not, however, as great as that at Waterloo in May, 1892, when the opening of a new signal-box led to the London and South-Western Company issuing a notice warning the public to be prepared for delays and when many inward trains did not travel farther than Vauxhall.

Notes and Memoranda.

There are, it is said, 140 million people in the world who listen in to wireless transmission. The value of wireless sets in commission is put at £200,000,000 and the cost of broadcasting at £30,000,000 a year.

The steelwork of the new sixty-nine-storey Rockfeller building in New York was finished on September 26th. The first foundation grillages were placed on February 8th. The building covers a plot 535ft. by 200ft., and contains 58,500 tons of steel.

A recipe for the removal of greasy or dirty finger marks from drawings is given as follows in the *Engineering News-Record*:—Place sheets of blotting paper over and under the stained portion. Lay powdered magnesia on the stain and under it, then press the blotting paper with a hot iron. When the powder is shaken off the stain will be gone.

To blacken brass for templet work, it should, according to C. R. Whitehouse, of Boston, Mass., first be thoroughly cleaned and then heated slowly over a charcoal fire. Care should be taken not to allow the brass to touch the charcoal or to allow any sparks from the charcoal to come in contact with it, as this will cause red spots. As soon as the brass has a slightly red hue, dip it into nitric acid and reheat it until it is just short of being red. Rub it strongly with a stiff bristle brush and clean with a greasy cloth. This gives a dead black finish, permanent enough for any lay-out work.

It would appear from a note in the *Journal of Commerce* that a considerable advance in the technique of soldering aluminium has been achieved by Mr. E. Jones, of the Department of Mechanical Engineering at the University of Liverpool. He uses a sharp-edged bit made of steel, which is surrounded by a Bunsen flame. The bit is used to scrape off the oxide film which naturally forms on the surface of the aluminium, and plain tin is applied to the surface of the metal within the flame. It is said that the tinning of the aluminium is quite effective and obviously provides a basis for a soldered joint.

Working in co-operation with refinery engineers of the U.S. Bureau of Mines, O. H. Schoenwald and G. M. Ford have developed a method of removing hydrogen sulphide from natural gas, based on reaction with lime. Treatment of the gas to remove the hydrogen sulphide was accomplished by scrubbing the gas with a solution of sodium chloride and calcium hydroxide. The salt solution appreciably increases the solubility of lime in water up to a certain percentage, and thus a smaller volume is required to remove a given amount of hydrogen sulphide. The treating plant consisted essentially of a scrubbing device for contacting the gas with the solution and a series of tanks for making up or settling the treating solution.

Pavements and lawns are no longer torn up in Baltimore when the gas company finds it necessary to change the pipes entering the premises of consumers. Instead of digging up the old service pipes for their entire length, with considerable damage to streets and yards, the new method involves only a small opening in the paving where the service pipe connects with the main. Through this opening the workmen cut off a 4ft. length of the service pipe. They also disconnect the house end and attach a length of new service pipe at the point of this disconnection. A pulling apparatus is then used for pulling the old service pipe toward the main, and 3ft. or 4ft. sections are cut off at the opening in the paving as the pulling proceeds, while 20ft. sections of the new pipe are added at the house end. This continues until the entire replacement has been effected. As much as 100ft. of new pipe has been pulled in this way without disturbing lawn or shrubbery.

Salamanders, lizard-like amphibians, have been shown to be responsible for the presence of *colon bacilli* in water obtained from springs otherwise free from bacterial pollution. A description of laboratory experiments and field studies on "Salamanders and Water Hygiene" appeared in *Natural History*. Controlled experiments in the laboratory showed that one salamander excreted a sufficient number of *colon bacilli* per day to contaminate 237 gallons of water heavily enough to be considered dangerous for human consumption. It is believed that salamanders act as reservoirs or incubators, and having once been infected with *B. coli* through their feeding habits while away from the spring, continue to excrete them as long as there is material in the salamander's stomach or intestines to supply nourishment to the bacteria. Autopsies performed during the summer showed a marked increase in the amount of food and the number of *colon bacilli* in the stomach and intestinal tracts. It is concluded that salamanders play an important *rôle* in causing certain water supplies to appear polluted, thus making if difficult to interpret the evidence of contamination.

The results of investigations, which are given in a Bulletin just issued by the Forest Products Research Section of the Department of Scientific and Industrial Research, indicate that a quality of home-grown Scots pine timber, equal to that of good quality imported red or yellow deal of joinery grade, can be produced in this country, but the rate of growth must not be excessive—that is, the timber should contain on an average twelve rings or over per inch radius. As no very slow home-grown timber was tested, it is not possible to state whether the choicest grades of the imported qualities can be produced in the British Isles. On the other hand, where strength is of primary consideration, an average of nine rings per inch radius is permissible, though the optimum strength is not reached until the growth has slowed down to approximately twelve rings to the inch. A rate of growth faster then nine rings per inch, not only means a rapid falling off in strength, but an equally rapid falling off in general quality and appearance, and the possibility of the use of such timber for better-class work is correspondingly limited. The investigation has clearly brought out that home-grown Scots pine timber grown in different localities varies considerably in weight and ranges from 25 lb. to 45 lb. per cubic foot at a moisture content of 12 to 15 per cent. The report can be obtained from H.M. Stationery Office, price 5s. net.

Miscellanea.

It is proposed to construct a bridge across the Krishna River at Karad, in Madras.

A shipbreaking yard is being organised on the premises of Richardson, Duck and Co., at Thornaby-on-Tees.

Since the beginning of 1932 thirty-one new manufacturing firms have started business in Greater Vancouver.

A whale oil refinery is to be put up at Churchill, Manitoba, by one of the largest soap makers of the world.

The new mining and technical college, erected at a cost of £110,000, towards which a grant of £15,000 was made from the Miners' Welfare Fund, was opened at Barnsley on October 10th.

A new type of the three-motor Fokker monoplane is being produced to enable the Royal Dutch Air Line to fly in five days from Holland to the Dutch East Indies with mails and passengers.

The Canadian Government proposes to construct a chain of airway landing fields from coast to coast *vid* Halifax, Montreal, Ottawa, Toronto, Winnipeg, Lethbridge, and Vancouver.

The new bridge which is being built across the Danube near Belgrade is 4900ft. long and about 40ft. wide. It is to carry two railway tracks and two roadways and includes seven spans of 530ft. each.

It is proposed by the Soviet Government to construct a series of power stations on the rivers Vytegra, Meta, and Lovet, in the Valdai district. The largest would be one at Damyansk, of 250,000 kW.

The first potash concentration factory in the U.S.S.R. is being started in Solikamsk this month. The factory is equipped with the most modern apparatus. Its capacity is 300,000 tons of potash fertiliser a year.

It is proposed by the British Cadastral and Topographic Air Survey Company, Ltd., of London, to organise in Vancouver a plant for the production of accurate maps. It is said that some 300,000 dollars will be expended on the scheme.

A memorandum on "The Industrial Diseases of Silicosis and Asbestosis" has been issued by the Home Office (Stationery Office, 3d. net). The memorandum states that "respirators can never be regarded as a substitute for exhaust ventilation."

Owing to the success attending the previous competitions, the Institution of Welding Engineers has decided to offer again the gold medal of the Institution and a prize of £10 10s. for the best paper by a working welder on "Improvements in Welding Practice."

Work has been started on the further development of the Pykara hydro-electric scheme in Madras in connection with a dam across the river near Mukurti, with the object of increasing the storage capacity. So far the work has consisted principally of surveying and boring, and the results are said to be promising.

It is stated that more than 7 miles of welding are involved in the construction of the new airship hangar at Sunnyvale, California. The dimensions of this structure will be about 1200ft. in length by 308ft. in width by 225ft. in height, and it will have the world's largest single unobstructed floor area, nearly 300,000 square feet.

According to the Geological Survey of the United States Department of the Interior, the Federal Government now has reserved 6,579,761 acres of land in twenty-one states and 447,756 acres in Alaska for future power reservoirs. These are said to be capable of producing 15,000,000 H.P. when economic conditions warrant.

The Polish authorities are preparing a plan for the establishment of a submarine cable connection with the northern countries, so as to be able to get direct communication and thus avoid the German lines. The proposal takes the form of the laying of a cable from Gydnia to Bornholm, whence the traffic would be continued by way of the cables which lie between Bornholm and Denmark and Sweden.

For the purpose of hauling pipe across the desert for the construction of the Iraq oil pipe line the Marmon-Herrington Company, of America, has supplied a petrol-driven vehicle with sixteen pneumatic-tired wheels. The tractor unit has six wheels and carries the front end of a four-wheeled trailer. Behind there is towed a six-wheel trailer. The equipment will carry 40 tons and has a total length of 100ft. The maximum speed is about 30 miles per hour.

A new reinforced concrete bridge is being built across the river Mersey between Latchford and Howley by Messrs. Bolton and Lakin, of Birmingham. The preliminary work, such as excavating and other operations below water and ground level, is now completed, but it will take probably another eight months before the bridge is ready for opening. The whole of the steel work for the centering, &c., is being supplied by the Pearson and Knowles Engineering Company, Ltd.

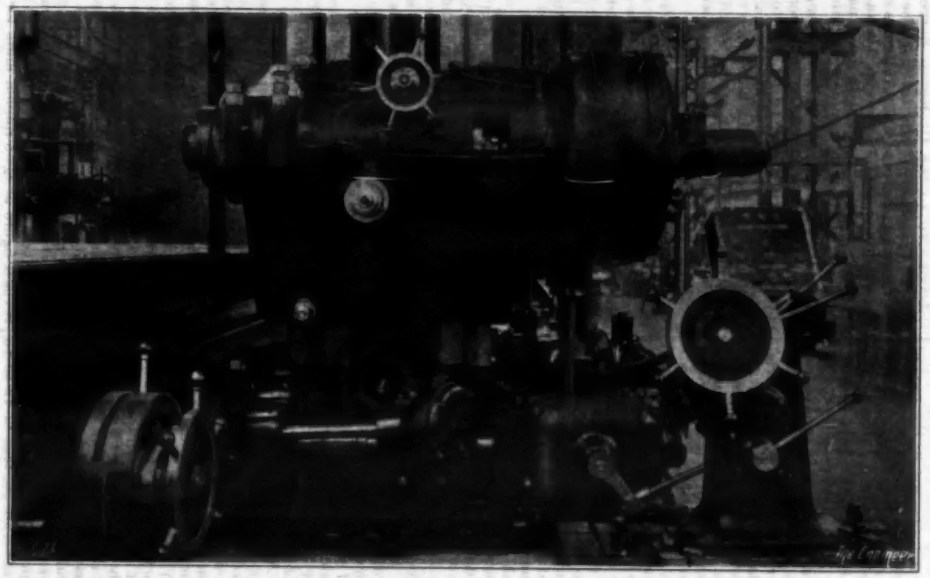
Construction work on the Moscow underground is showing fair progress. The first line, which is to connect the Sokolniky district with Krimsky-square, has been divided into five sections. Preparatory work is practically completed, the foundations of the houses under which the subway is to be built have been tested, the ground investigated, and drilling is going on at the points where stations are to be situated. Considerable progress has been made in the building of one station.

The official returns rendered to the Electricity Commissioners show that 922 million units of electricity were generated by authorised undertakers in Great Britain during the month of September, 1932, as compared with the revised figure of 875 million units in the corresponding month of 1931, or an increase of 5·4 per cent. During the first nine months of 1932 up to the end of September the total amount of electricity generated by authorised undertakers was 8632 million units, as compared with the revised figure of 8058 million units for the corresponding period of 1931, representing an increase of 574 million units or 7·1 per cent.

OPERATING PANELS, CONTROLS AND DRIVES OF HEAVY DUTY PLANO-MILLING MACHINE

KENDALL AND GENT (1920), LTD., MANCHESTER, ENGINEERS

(*For description see page 386*)



CONTROL GEAR AND OPERATING PANEL

WORM DRIVE TO TABLE

MOTOR AND GEAR-BOX FOR TABLE AND SADDLE FEED

SWIVELLING HORIZONTAL SADDLE AND CONTROL PANEL

The Engineer

OCTOBER 14, 1932.

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**** No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

ROAD AND RAIL.

ALTHOUGH the discussion of the Road and Rail problem was exacerbated rather than mollified by the publication of the Salter report, we have refrained from taking part in it believing that in the course of time the broad and sensible view would prevail, and that the differences would be swallowed up in the desire to make the best of both systems of transport. We are, however, impelled to return to the subject by a memorandum which the Federation of British Industries has sent to the Minister of Transport in response to his request for an expression of views upon the Salter report. In drafting this memorandum the F.B.I. had the assistance of a special committee, and its findings were endorsed by the Grand Council. It claims that in formulating its views, it has "regarded the question at issue from a broader standpoint" than that imposed on the Conference on Rail and Road Transport. Yet we find that "its views are put forward as representing the interests of manufacturers and industrialists who are materially affected by the problems examined by the Conference, both as producers and as the main users of transport." It is not easy to regard views, so circumscribed, as wider than those of the Salter Committee, but a justification of the claim is perhaps afforded by the last paragraphs of the memorandum, which propose, in substance, that the cost of railway transport should be reduced, rather than that the cost of road transport should be raised. In other words, whilst the Salter Committee took the railway position as a basis to which the road position had to be levelled up, the Federation proposes to reverse the process and level down the expenditure of the railways until they are in a position to compete with road services. Great and successful efforts are being made by all the railways to reduce their outlay, but even if they should result eventually in a considerable diminution of rates, the fact would still remain that the roads as commercial routes enjoy certain facilities denied to the railways, and that competition is therefore not on a wholly equitable basis. The Salter Committee endeavoured to establish that equity by proposing that commercial road vehicles should be called upon to bear their due share of road maintenance, some of which is now borne by private cars.

The railway representatives at the Conference on Rail and Road Transport (the Salter Committee) put the position in a nutshell. They said they did not ask "for any action which would tend to secure a different division of function than would result if a single administration, without divergence of financial interest, were solely occupied in meeting the needs of the public by the most convenient and economical arrangement of transport." That, we suggest, represents the attitude of mind in which this problem should be debated. Now if such a single administration existed, it would certainly endeavour to reduce the expenditure of the railways to that of the road, and it, assuredly, would be interested in the F.B.I.'s proposals that the disabilities under which the railways labour should be removed. But it is equally certain that if its accounts revealed the fact that the road was enjoying facilities denied to the railways, it would immediately say the basis of comparison was wrong. Furthermore, if it found that its irreplaceable railway service was suffering in consequence, and that railway rates were tending to rise by reason of the fall in revenue, would it not take steps to remove the inequitable conditions by debiting the road with the charges which it ought, in fairness, to bear? Such an administration would not regard the rail and the road as competing organisations, each of which was justified in taking advantage of any favourable conditions at the expense of the other, but as the complementary parts of a national service, neither of which was greater or less than the other. If the problem is looked upon in that light, it seems to be beyond contention that when the Salter Committee advised that the commercial road vehicle should be deprived of the subsidy which it now receives from the taxation of private vehicles, and that it should bear its fair share of the cost of the roads, it was endeavouring to put the Road on the same level as the railways. We are glad to observe that the F.B.I. agrees that "some redistribution of the burden of taxation is necessary," but we are unable to follow it when it objects to that redistribution falling in part on coal and heavy oil burning vehicles. Why, we may ask, should selected vehicles pay less towards the upkeep of the roads than others which are not more, and may be less, injurious to them? The sensible suggestion is made by the Mansion House Association on Transport, which has also sent comments on the Salter report to the Minister of Transport, that the possibility of reducing future expenditure on roads should be investigated. At present the maximum amount of manual labour is used on the highways in order to reduce unemployment and the cost is high. When it is diminished by the greater adoption of machinery the annual expenditure of £60,000,000 will fall, and the taxation of industrial vehicles should be reduced in consequence. If that is done the railways will have no right, and we are confident will not attempt, to complain, for they will recognize that the principles of equity between the Rail and the Road have not been disturbed. Turning to another point we find the F.B.I. expressing a fear that the new restrictions may have "disastrous effects on newer forms of locomotion which have not yet reached their full development." In other words, it desires that these "newer forms" should enjoy a subsidy at the expense of the older. For ourselves, we have little or no fear that the progress of the heavy oil vehicle, which is obviously indicated, will be appreciably checked if the proposals of the Salter Conference are adopted. The object to be kept in view is not the encouragement of any particular form of vehicle, but the putting of the whole system of surface transport on a thoroughly equitable basis.

We have not endeavoured to present all the comments made seriatim on the Salter Report by the F.B.I. Many of them seem to us to have been written too much in the "interests of manufacturers and industrialists," and too little in the interests of the country as a whole. We cannot but regret that a body holding the great position of influence which the Federation enjoys has concerned itself with small matters and has allowed the interest which we are persuaded it feels in the whole transport industry of the country to be swamped by what must appear to the reader to be perilously near partisan interests. Either the Road and the Rail have to be placed on an equitable basis of competition, or they have not. If they have, then the proposals put forward by the Salter Committee would seem to be worthy of acceptance in substance, if not in absolute detail. If they have not, then there is nothing to be done but to leave affairs in the present unsatisfactory condition. We do not believe that the F.B.I. desires the latter, but the only alternative it has to offer is the removal of disabilities suffered by the railways. We are confident that had the Conference seen any way by which that could be done, it would have made recommendations to that effect. Is it not significant that it did not do so, and that the Royal Commission on Transport did no more than "wonder whether in present circumstances regulation is not overdone in certain directions?"

The Paris Motor Car Show.

THE annual show of motor cars, which was opened in Paris last week, reveals that the French automobile industry has set itself out to deal with problems that experience of the past year or two has shown to have compromised to a certain extent the future of the motor car trade. There can be no question of any decline in the popularity of the motor car, which has become a necessity, more or less complete, to all classes of the community, but the number of cars now in service has introduced an element of danger that can not be wholly removed by the technical advance in automobile construction. This is not the fault of manufacturers, who build cars that are entirely reliable, and are admirable examples of the engineering industry, and there are remarkably few cases in which accidents are caused by mechanical defects in the vehicles themselves. Nevertheless, the toll of life in France, though less than in Great Britain, is so heavy that the greatest problem now set the manufacturer is to do all he can to reduce it by eliminating risks arising out of the nervous reflexes of drivers. In France, which stands second in the proportion of cars to the population, the examinations for driving licences are sufficiently severe to eliminate those who are obviously incapable, but as so large a number of owners only drive their cars intermittently, and often lay them up for the winter, skill acquired in driving does not dispense with the necessity of extreme care when taking the car out on the crowded roads after a long rest. The attempts to educate motorists to a sense of caution can never be fully successful, and the only way to lessen the lamentable loss of life arising from reckless or inexpert driving is to improve those parts of the car that insure stability, perfect control, and absolute reliability in steering and braking. It is because manufacturers have concentrated their attention on these features of car design that the Paris Show appears to be lacking in outstanding novelty. But whilst there is no attempt to introduce new ideas and principles, the Show may be nevertheless regarded as one of the most interesting yet held.

One factor that influences the motor car industry is the lowering of prices, which is the natural consequence of the general depression. This has taken place at a time when general costs in France are rising, though makers affirm that steps adopted with a view to effecting economies enable them to maintain their margin of profit. Prices have had to come down for the small and medium cars, on account of the country's lower purchasing power, and also because there is always the pressure of foreign competition, notwithstanding the ample protection that is afforded to French makers. The necessity of reaching a great number of users has therefore given more prominence to the four-cylinder engines for the smaller cars, though for the bigger vehicles six and eight cylinders are general. The object of makers is to give to the smaller cars the same comfort, ease of control, and flexibility that is found in the more powerful vehicles. Since this is done to a large extent by adopting devices that are not particular to any one country, the resulting designs have an almost international character. The free wheel is growing in favour on account of the recognised economy in fuel consumption which it effects, but it is only suitable for touring, and when the car is used in town has to be kept locked. More attention has been given to springing, the springs being invariably supplemented with dampers, and in some cases the system of carrying the wheels between two transverse springs has been revived. On account of the speeds at which light cars can be driven, it has become a complicated problem to prevent the wheels from jumping, but the spring and damper devices now employed for keeping them on the road are often quite efficient. Yet most of the arrangements are more or less in the nature of makeshifts, though satisfactory. The same desire

to provide safety and comfort has induced makers to suppress engine reaction on the frame by coming back to the old three-point suspension, but it is improved by the use of rubber blocks and other means of insulating the body from engine vibrations. The frame, too, is made more rigid, in some cases with large section rectangular tubes built up with rather light gauge steel strip pressed and spot welded. Bracing the frame is also carried out more extensively. Gears with helicoidal wheels in mesh and other devices for silent gears and easy changing are often fitted to the smaller cars, and servo-declutching arrangements are sometimes adapted to the lighter vehicles, so that what is offered represents more value for the lower price the buyer is required to pay. Cars of less than 6 to 8 horse-power, made by mass production methods, are rare. The voiturette has disappeared, its place having been taken by the motor cycle, which has encroached on much of the space in the Grand Palais formerly occupied by small cars. Everything outside standard construction is marking time or retrograding, though various new systems are still to be seen, and the front-driven vehicle holds on despite the lack of interest in a method of transmission in which undoubted merits are discounted by drawbacks.

So long as the automobile industry labours under the present adverse conditions, there is necessarily competition which compels manufacturers to adopt mechanical devices that will tend to an improvement in convenience or efficiency, but they cannot afford to risk introducing radical changes when the existing types have, by dint of careful attention to detail, reached a degree of perfection that gives satisfaction to all classes of users. Even the attempts to replace petrol by other fuels in France have been abandoned, at all events for other than commercial vehicles. Makers of light solid injection engines do not despair of doing something with touring cars, and there are one or two exhibits of this kind at the Show. There may be possibilities in the future for further automobile development, but for the moment manufacturers have done the best they can within the limits of the prices that buyers can now pay, and they hope that the really satisfactory and attractive cars they have now put on the market will stimulate buying in the coming season.

The Institution of Mechanical Engineers in America.

No. III.

The Welland Ship Canal.

On the morning of Saturday, September 3rd, we left Hamilton in motor coaches for a day of travel by road, which was to end by bringing us to Niagara. At first we ran through mile after mile of Ontario's orchard country, where trees heavily laden with luscious peaches bordered the unfenced highway and seemed to invite the passer-by to help himself.

In due time we reached Port Weller at the Lake Ontario end of the Welland Ship Canal. This canal, officially opened to traffic during the Ottawa Conference, is the fourth which has been constructed during the past hundred years to short-circuit the Niagara River and Falls, and thereby enable ships to pass between Lake Ontario and Lake Erie. It runs more or less parallel with the Niagara River and lies wholly in Canadian territory. It is, in fact, a purely Canadian enterprise built at the expense of the Dominion taxpayer, but it is, nevertheless, toll-free to all nationalities. The canal has a total length of 25 miles and provides an aggregate drop or lift of 326½ft. equally divided over seven locks. An eighth lock at the Lake Erie end regulates the summit level without a drop or lift. The canal is constructed to accommodate vessels up to 30ft. in draught and 80ft. wide. It is, therefore, ready as it stands to fit in as part of the St. Lawrence Waterway Scheme. On the average ships take about 8 hours to pass through the canal. At Port Weller the party paid a visit of inspection to the gate-lifting pontoon, a self-propelled craft with a high tower-like structure at its forward end designed to facilitate the removal and replacement of any of the lock gate leaves—each of which weighs 500 tons—in the event of damage being done to them. Continuing along a road substantially parallel with the canal, we halted near the township of Thorold to inspect a stretch of the canal in which four of the locks occur in a distance of a little over a mile. Three of these locks are grouped in one flight and are constructed with double chambers, one for upbound and the other for downbound traffic. At the foot of these flight locks the canal power-house is situated. It is equipped with three hydro-electric generators of 5000 H.P. each. The flight locks occur at the "escarpment," the great cliff-like drop which traverses the Niagara Peninsula, dividing it into high ground on the Lake Erie side and low ground on the Lake Ontario side, and over which, no doubt, the Niagara River at one time tumbled before it cut the gorge, 7½ miles long, back to the present position of the Falls.

Near Thorold the party diverged from the canal route to partake of luncheon at the Lookout Point Country Club, by invitation of the Welland County Ship Canal Industrial Area Commission. Resuming the journey, we completed the traverse of the canal at Port Colborne, on Lake Erie. Thereafter we turned eastwards for Fort Erie, at the upper end of the Niagara River.

We have no distinct recollection of Fort Erie. In fact, we have grave doubts whether we really visited it. No one seemed very clear on the point, and the general impression appeared to be that our drivers took a short cut. Presently, however, we were all fully astir, for by one route or another we had reached the side of the Niagara River at a point above the Falls where it flows placidly between low and level banks. Past Grand Island, past Navy Island, past the upper rapids, and then a cloud of steam, seemingly, ascending from the middle of the river, told us that we were just about to arrive at the spot where the waters plunge down into the as yet unseen gorge below. Almost simultaneously we realised that the opposite bank of the river was United States territory, that after journeying some 3500 miles from home, we were at last gazing on a portion of the famous "far-flung bottle line." Concrete evidence of the fact was not wanting. Lying on its side in midstream, stranded, precariously it might seem, on a rock almost at the very lip of the Falls, was a bootlegger's launch. That it still contained its precious cargo we were assured, but what became of its human occupants on the dark night two years ago when it came floating down the river no one knew.

Niagara.

Our hotel, the Clifton, was situated a little below the Falls, and from its verandah afforded an unsurpassed view of them. Here, perhaps, it may be explained that when one speaks loosely of Niagara one may mean either a river, or two falls or three towns. The Niagara River, 35 miles long, is the outlet by which Lake Erie discharges its waters into Lake Ontario. About half-way along its length Goat Island divides it into two streams, each of which, at the lower end of the island, tumbles separately over a rocky cliff about 163ft. in height. Goat Island is wholly in United States territory, and the fall of water between it and the United States side of the river is known as the American Fall. Between Goat Island and the Canadian bank is the larger and grander Canadian or Horse-shoe Fall. On both banks large towns have grown up, partly as a result of the tourist traffic, and partly because of the industrial undertakings which have been attracted to the spot by its cheap and abundant supplies of hydro-electric energy. On the one side is situated the town of Niagara Falls, Province of Ontario, and on the other the quite distinct town of Niagara Falls, State of New York. They are joined by the International Bridge, a single-arch structure spanning the gorge just below the Falls and guarded at the respective ends by the Customs and Immigration Officers of the two countries. The third town is Old Niagara, or Niagara-on-the-Lake. It lies 15 miles below the Falls at the outlet of the Niagara River into Lake Ontario, and was originally the capital of "Upper Canada."

Over the first 19 miles of its length the Niagara River has a drop of only 11ft., and flows along almost sluggishly without any indication of the approaching fall. The twentieth mile, however, sees a profound change in its character. The river shallows to 10ft. or 15ft. deep, and in the course of the mile drops 51ft. in level. This stretch forms the upper rapids, at the end of which the seething waters, split by Goat Island, plunge in clouds of spray over the American and Canadian Falls. After the drop of 163ft., the waters commingle in a large pool reaching in places to a depth of 185ft., and having a length of 2½ miles. In this pool the water, on the surface at any rate, is sufficiently undisturbed to permit a small steamer, "The Maid of the Mist," to sail almost up to the Falls. The drop in the river's level through the pool is only 6ft. Thereafter the bed again becomes shallow, 30ft. to 40ft. deep, but in the course of three-quarters of a mile it drops 50ft. in level. This short stretch constitutes the Whirlpool rapids, and through it the water roars, to be caught at the foot by a bend in the river. The Whirlpool, formed within the bend, is 120ft. deep, and, with the rapids immediately above it, provides a scene scarcely less grand and inspiring than the Falls themselves. Across the Whirlpool from cliff to cliff modern enterprise has constructed an aerial ropeway for the benefit of tourists with steady nerves. It seemed to us a wholly needless addition to the natural wonder and historic interest of the scene. We turned away from it to search for the Devil's Hole, the tragic chasm on the United States side which in 1763 witnessed the extermination of a British convoy by the Senecas, and, within a few hours, the ambuscading of a party of British soldiers bravely hastening to rescue or revenge their comrades.

Over the next 4 miles, after leaving the Whirlpool, the water drops 42ft. in level in yet another rapid, at the foot of which it passes clear of the Escarpment. Thereafter, its troubles over, the river for its final 7½ miles flows once more peacefully between low banks until it enters Lake Ontario.

The total drop of the river in its length of 35 miles is 326ft., but it will be noted that almost the whole of this drop—314ft. to be exact—occurs in the length of 8½ miles from the start of the upper rapids to the Escarpment. It will further be noted that of the total drop, that at the actual Falls is exactly one half, the other half being accounted for in very large part by the drops at the three rapids. This fact explains why the most recent hydro-electric station on the river, the Queenston station of the Ontario Hydro-electric Power Commission, is not situated, like the older stations, hard by the Falls, but some 6½ miles below them, close, in fact, to the Escarpment. This station has ten main units, with an aggregate peak-load capacity of 550,000 horse-power. Its turbines are situated practically at the level of the river surface, and are fed by penstocks, which run up the face of the cliff to a forebay at the edge of the gorge. This forebay receives its supply from a canal 12¾ miles in length, which draws off water from the Niagara River at the village of Chippawa, about 1½ miles above the Falls. Actually, the first 4 miles of this canal at the Chippawa end were formed from the Welland River, formerly a tributary of the Niagara. The natural flow through this section has been reversed in direction, and the Niagara water taken in through it, supplemented by the flow from the truncated Welland River, feeds the Chippawa-Queenston power canal. The power station in this manner utilises not only the head of the actual Falls, but the very considerable additional drop which occurs in the rapids. The head under which it works varies, in fact, from 294ft. to 305ft., or about 88 per cent. more than the head obtainable at the Falls themselves.

The Queenston power station was the only industrial establishment visited by the party during its stay at Niagara from the evening of Saturday, September 3rd, to the morning of Tuesday, September 6th. Sight-seeing expeditions, organised or unofficial, occupied a goodly portion of the remainder of the time. On the evening of arrival the party was entertained to dinner by the Ontario Provincial Government at the Refectory, an establishment maintained for the refreshment of visitors and tourists by the Niagara Parks Commission. That Commission, created more than forty years ago by an Act of the Ontario Legislature, is charged with the duty of preserving and increasing the natural beauties of the Falls, the river, and the Niagara frontier in general. It now has under its control a series of beautiful parks, totalling more than 1700 acres in area, joined by boulevards and well-paved roads. The results of its unpaid labours are obvious from a casual comparison of the Canadian with the United States side of the river. On the Canadian bank there is little to offend the eye, and very much to delight and impress it, but on the United States bank man's work has been allowed unnecessarily to intrude on Nature's beauty and grandeur. We will, for instance, go far before we again see spread out before our eyes a prospect as noble and harmonious as that on which we gazed from the Commission's great park at the edge of the Queenston Heights. On the other hand, we would willingly forget the ugly factory buildings and the cheap-jack streets on the United States side. Nor is the contrast confined to the material. Typical of the difference in another way was the United States officer's "Anything to declare, folks?" as we sought ingress to his country at the International Bridge, and the mirrors and ground lights in the roadway which enabled him to see beneath our car with hardly a movement of his head. We contrast that greeting with the cheery "All British?" which sufficed to readmit us on to Canadian soil.

On the afternoon of September 4th Mr. C. L. Stevens, of Boston, addressed an assemblage of the members on "The Point Plan of Rewarding Management and Labour." It was, however, a warm, bright Sunday afternoon. In the background we could hear the modulated roar of Niagara and a gentle breeze from the open windows set the glass chandeliers tinkling drowsily. Withal, the acoustics of the room were not of the best, and at times made it difficult to catch more than a word here and there of the speaker's discourse. In short, what with one thing and another, we failed almost completely to gather anything about the "point system," except that it provides a new basis, involving the assessment of the worker's output of personal energy, for the payment of wages. We do not, however, wish to belittle its importance or to criticise the inclusion of Mr. Stevens' address in the programme of the trip. Fairness compels us to record that subsequently we found the system in use in two of the works visited in the United States—at the Kodak Company's works in Rochester and at the Stromberg-Carlson Telephone Company's establishment in the same city—and that we heard good accounts of it.

It was in a somewhat different atmosphere that the bulk of the party assembled on the evening of the same day to hear an address by Mr. L. B. Duff, a member of the Niagara Historical Society, on the

* No. II. appeared October 7th.

war of 1812 and the particular features and incidents of it of interest to visitors to the Niagara frontier. Mr. Duff entertained us all by his scintillating wit, and if any one had a complaint to make, it was that the time alloted him did not permit him to delve at all deeply into the authentic historical side of his subject. We should have liked to have heard much more than we did about the battles of Chippawa and Lundy's Lane, about Laura Secord, and how through peril and flood she brought news of the enemy's approach, and about the brave, unfortunate General Brock who fought and fell at Queenston Heights. Above all, not a few of us would have welcomed enlightenment on the causes and results of the war. It has largely faded from most people's common stock of historical knowledge. Yet it lasted for more than two years, and was waged with much bloodshed on both sides. It arose out of our blockading policy during the war with Napoleon, and was distinguished by our successes on land and our defeats at sea. From it the United States Navy dates its beginning as a world force. From it also dates the century of peace between the two nations, which is fittingly commemorated by the Great Peace Bridge across the Niagara River at Fort Erie.

British-Canadian Trade.

On the evening of September 5th a "round-table conference" was held to discuss methods of improving trade relationships between Canada and Great Britain. It was a somewhat one-sided kind of conference, for, with the exception of Captain Wiseman, His Majesty's Trade Commissioner at Toronto, and Professor Allcut, an Englishman born and bred, only one Canadian made his voice heard. Professor Alicut opened the meeting. The Canadians, he said, were loyal to the Empire, but the trade contacts between them and Great Britain were, nevertheless, remarkably few. There were undoubtedly natural difficulties in the way of increasing trade between the two countries. For example, there were the distance between them, the cost of transport, and the extended period required for delivery. These natural difficulties were, however, supplemented by some which were purely artificial. Few British firms kept adequate stocks in Canada, others offered products which were not suitable to the Canadian market; yet others failed to realise the importance of good service following a sale; many were niggardly in imparting information about their goods; and, finally, in not a few cases the wrong type of man was selected as local representative.

Following Professor Allcut's frank and undisguised criticism of our manufacturers' ways, Captain Wiseman dwelt upon some of the difficulties in which Canada's proximity to the United States places British firms seeking to do business in the Dominion. The similarity of climatic conditions, the adoption of the same standards of finance and design, the ease of consultation with the manufacturers, and the quickness of delivery without transhipment—all these factors influenced the Canadian buyer in favour of placing his orders in the United States rather than in Great Britain. As a result, the Canadian had become dependent upon the assistance of the United States, and his dependence had been accentuated by the prevalence of hard times and of the consequent extension of hand-to-mouth buying. The British manufacturer, Captain Wiseman continued, did not know enough about Canada, whereas the United States manufacturer knew the country through and through. Products which sold well in South Africa or Australia were not necessarily suitable for the Canadian market. It was useless to tell a prospective customer that what one had ready for sale was what the customer wanted, if one really did not know the true conditions of the customer's market. Like Professor Allcut, he laid great stress on proper representation. In many cases British firms were inadequately represented in Canada, and were, as a consequence, not receiving their proper share of trade. The most satisfactory arrangement, he held, was to establish a branch office in Canada, and to staff it with fully qualified technical representatives from the home factory. Co-operative representation was also worthy of consideration. Much good, too, might also be done by the attachment of industrial engineers to the offices of the non-technical trade commissioners. Finally, he emphasised the growing preference given in Canada to Dominion products and suggested that to meet it British manufacturers would be well advised to arrange for at least parts of their products to be made in the Dominion.

Several other speakers took part in the discussion. One of them spoke up stoutly for the ability of British manufacturers to beat their United States rivals on Canadian soil if they wanted to do so, and if they were adequately advised of the manner in which to do it. As a particular instance he mentioned the case of an English firm making machine tools. That firm, he said, following enlightened advice, now gave its Canadian customers not only what they wanted, but something more than they wanted, and at a price, too, hundreds of dollars less than that of its former United States competitors. The spirit animating that firm was not, however, universal, although many others could achieve a similar result if they desired and had sufficient initiative. Freight charges did not really constitute a difficulty. They did not, in fact, count at all compared with other factors which entered into the situation. There was plenty of opportunity for British firms to improve their trade position in Canada. The declared policy of the Dominion was to purchase Canadian goods first, British second, and United States third. The actual position was substantially that 80 per cent. of the orders were placed in the United States, 19·9 per cent. in Canada itself, and the balance in Great Britain. These figures are, perhaps, not to be taken as mathematically accurate. How remote in fact they are from being serious is shown by the fact that of Canada's total imports in 1930, 15·2 per cent., representing nearly 38 million pounds sterling in value, came from the United Kingdom. In the same year the United States imports into Canada amounted to 67·9 per cent. of the total and were valued at 169 million pounds.

Another speaker raised the very pertinent question as to the general adoption of British standards in Canada. Were Canadians alive to the real value of B.S.I. standards, or did they definitely prefer the United States standards? No Canadian engineer, unfortunately, was present to answer him, but the President, Mr. Taylor, subsequently informed him that Mr. Le Maistre, of the British Standards Institution, had just returned from a tour undertaken with the object of promoting the general adoption of British standards throughout the whole Empire.

Canadian and United States purchasers, said another speaker, might seem fussy at times, and to require many details in their machines which appeared superfluous to the British tenderers. There was, however, a reason for every one of them. One was that the staff which would operate the machines would be nationally heterogeneous. It would be composed not of British workpeople, but of operatives drawn from six or more different nationalities. He knew of one plant near Niagara at which the works' rules were printed in six different languages, including Ukrainian, Rumanian, and Czecho-Slovakian, and at which the foremen could not converse with all those under them. The language difficulty was one reason why the machines had to be made foolproof and to be designed to ensure certainty of operation.

One stout defender of the British manufacturer arose to comment on the Englishman's characteristic tendency to decry himself—of which tendency there did seem, in our ears, too much evidence at the meeting. He asked us to picture a similar discussion among United States engineers and to listen in imagination to the complaints which would be made concerning the difficulties encountered in selling United States goods in Great Britain. He begged Canadian engineers not to take to heart all that had been said that night. The direction which the discussion had taken was, he held, to be deprecated. Much of it had centred round trivial and isolated complaints which could readily be rectified. The real trouble was caused by the fact that Canada had chosen to standardise United States goods instead of British, as she might have done, and had established her industries largely with the aid of United States capital. Without a doubt the United States had encouraged Canada to adopt its standards rather than British standards in order that the Dominion might be bound to make its purchases from the States rather than from us.

The last speaker to take part in the discussion was a native-born Canadian engineer. He asserted his emphatic loyalty to the Empire and his family sympathy with Great Britain, but he urged us not to rely wholly on sentiment. It was essential, he said, to attend to details. The climatic conditions in Canada made it imperative in many cases that contracts should be completed before cold weather set in. For that reason, facilities for giving almost instant delivery and for affording constant service afterwards were factors which told heavily in favour of success in the securing of orders. While complaints were sometimes heard regarding the quality and nature of British manufacturers' catalogues and descriptive literature, his own experience was that the advertisers in British technical journals responded well to inquiries and sent out satisfactory information. Frequently, however, difficulty in proceeding farther was caused by the absence of agents in the Dominion.

The discussion as a whole was undoubtedly interesting and illuminating. We came away from it, however, with two impressions uppermost in our minds. First, it was really a discussion on how Great Britain could improve her trade with Canada. Not a word, except for an almost casual remark by Mr. Horace Boot, was uttered concerning the reverse aspect—how Canada could improve her trade with us. Yet, unless our reading of the economic situation is wholly topsy-turvey, it seems certain that the two aspects are essentially complementary and that improvement of trade in one direction must go hand-in-hand with its improvement in the other. Secondly, Canada's propinquity to the United States is the real key to the situation. It is a fact of physical geography and cannot be eliminated. It is useless to rely on sentiment. The Canadians are loyal to the Empire, and the nearer they live to the United States frontier—or so we found it to be—the more intense is their loyalty. But it is futile to shut one's eyes to the fact that Canada's back door is about 3000 miles wide, and that directly beyond it lie the principal industrial and manufacturing centres of the United States. If, then, we would prosper in our trade with the Dominion, we must neglect no single means of mitigating the disadvantage under which we lie by virtue of our remoteness from Canada. A word of warning as regards the future may not be out of place. The St. Lawrence deep-waterway scheme, "in the whole gamut of world engineering a project second only to the Panama Canal," will, if it is carried through, certainly enable us to send our ocean-going transports right to the head of Lake Superior, to a point only about 900 miles from the edge of the great prairie wheat belt. It will also, however, do very much to facilitate the flow of iron, coal and manufactured products from the United States to Hamilton, Toronto, Montreal and the other industrial centres of Ontario and Quebec. We must not count the gain from the completion of the scheme as certain to be wholly on our side.

(To be continued.)

South African Engineering Notes.

(By our South African Correspondent.)

State Steel Works.

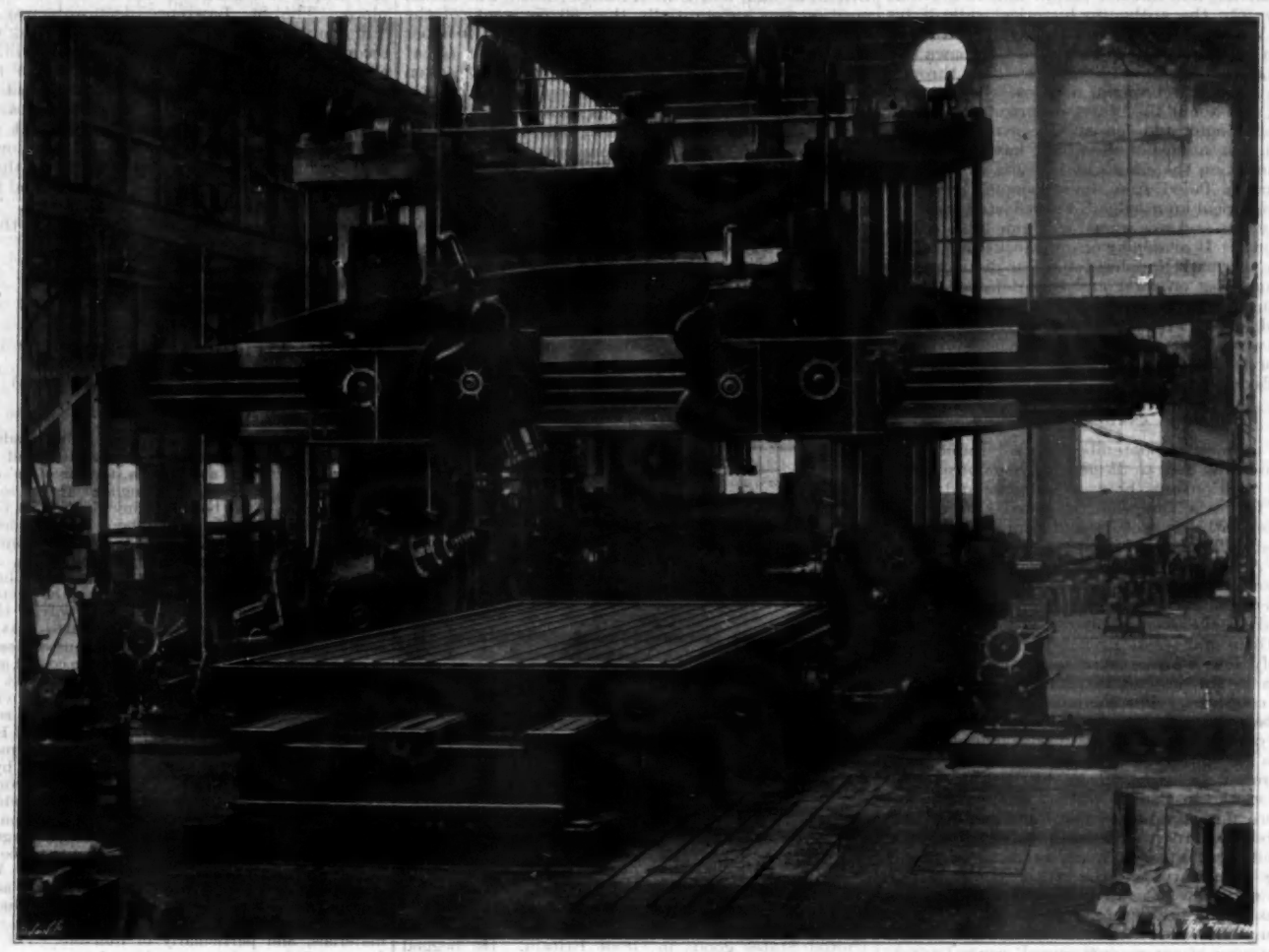
With the steady progress being made with the erection of the South African Iron, Steel and Industrial Corporation's works at Pretoria, the directors' confidence in the success of the undertaking appears to grow greater. The chairman of the board of directors, who is, of course, a Government nominee, has unbounded confidence. The Corporation has, he states, made a detailed investigation of probable production costs, consumption, marketing conditions, and selling prices, and on the basis of an output of 150,000 long tons per annum the Pretoria works will supply a relatively small portion only of the Union's requirements. Moreover, it is estimated that the gross profit on a turnover of 150,000 long tons of steel products per annum will be sufficient to meet the cost of administration, general and commercial charges, interest on debentures and contingencies, and beyond that provide for the redemption of debentures, depreciation and reserves, as well as reasonable dividends on "A" and "B" shares. The Corporation's market will be the inland market, and particularly the Witwatersrand, which is by far the largest market in South Africa for such commodities. That being so, the Corporation, states the chairman, is placed in an advantageous competitive position by reason of the location of its works and the railage charges, ranging from 25s. to 127s. per ton, which have to be borne by imported iron and steel products railed to the Witwatersrand. The South African industry has other advantages, mainly in the direction of assuring low production costs for the Pretoria works, namely:—(*a*) The low cost of raw materials, and particularly of iron ore. For the blast-furnace charge it is proposed to use an ore mixture consisting of 80 per cent. hematite ore from Vliegpoort and 20 per cent. silicious ore from the Pretoria Townlands adjacent to the steel works site. The Vliegpoort ore can be loaded in the bunkers of the blast-furnace at Pretoria for less than 10s. per ton of 2000 lb. and the Pretoria ore at less than 3s. 6d. per ton of 2000 lb. (*b*) The works will be practically a self-contained unit producing their own coke and their own pig iron. (*c*) The plant and works being specially designed and laid out for the conservation of heat and mechanical energy. (*d*) A plant is being installed to recover by-products from the coal during coking operations. These by-products fetch relatively high prices in South Africa, and should have an important influence on the economic results of the works. (*e*) The estimated works cost of producing pig iron and steel at Pretoria compares favourably with the corresponding costs in Europe. The chairman has previously mentioned the advantage the works has in cheap native labour. The Corporation is now inviting the public to participate in the issue of a further 1,750,000 ordinary "B" shares of the value of £1 each, for the purpose of providing further funds to meet expenditure accruing on works on site, for the purchase of plant, machinery, and equipment, for which contracts have been placed, and this money, no doubt, the Government will, as before, have to get from the taxpayers. The estimated total capital expenditure is now put at £5,489,335, the actual amount expended to June 30th, 1932, being £1,366,586. The plant which is being installed includes: (1) A battery of fifty-seven coke ovens, capable of producing 450 long tons of blast-furnace coke per day, together with a by-product department consisting of a plant for the distillation of tar and the recovery of naphthalene, and an ammonia liquor and benzol recovery plant; (2) one blast-furnace with an estimated output of 350 to 500 long tons per day, equipped for a hearth diameter of 17ft., but capable of being lined for a diameter of 15ft. 4in.; (3) two steel melting tilting furnaces and one tilting mixer furnace; the steel melting furnaces will each hold 100 tons of molten metal and the mixer 400 long tons; (4) two comprehensive mills capable of rolling a wide variety of sections, one a combined rail and structural mill which will take 2-ton ingots, and in which rails, sheet bars, steel sleepers and structural sections will be rolled, and the other a combined rod and bar mill capable of rolling such sections as fencing standards and droppers, reinforcement and wire rods and small merchant bars and sections. Much of the erection work has been done. Work on the coke ovens is proceeding. The shells of the blast-furnace, stoves, and dust catcher have been completed, and the ore bunkers are well advanced. Over 3000 tons of structural steel and three 110-ton cranes have been erected in the steel melting department, and the erection of the mixer and steel furnaces is now proceeding. In the rolling mill department over 1400 tons of structural steel have been erected. It is believed that the works will be completed next year or early in 1934.

Cape Town Harbour.

All work in connection with the new basin at the docks has been stopped now. Work has also been discontinued on the extension of the breakwater. This

LARGE HEAVY-DUTY PLANO-MILLING MACHINE

KENDALL AND GENT (1920), LTD., MANCHESTER, ENGINEERS



step is due to the depression and because shipping was temporarily falling away. There are completed deep-water berths in the new basin, which will be able to cope with any revival in trade for some years to come. The Random Block Mole, which forms the southern side of the basin, has been pushed out for about 5300ft., and ships have already been berthed at the quay on the northern side of the dock. About £2,000,000 has been spent on the new scheme, the northern quay alone having cost about £470,000. The breakwater, which will be extended by 1500ft. when completed, has now been carried out more than 1200ft., so that ample shelter is afforded to the few steamers that occasionally lie at anchor during the week-ends. More than 80 per cent. of the necessary dredging has been completed, and thousands of tons of sand and stones have been pumped ashore or dumped to form a huge area of valuable land on which have been built sheds and a network of railway lines.

Rhodesia Seeks a Port.

How acutely Rhodesia feels the need of a port which she can regard as her own is shown by the interest which has been excited by the discussion on the feasibility of exploiting Tiger Bay, on the west coast. The Walvis Bay project has dropped more or less out of sight since the Union Government took up an attitude which left no doubt as to its disapproval. It is doubtful if the movement favouring Tiger Bay will have any better success. Northern Rhodesia cannot complain that it is not fairly well served, because, in addition to the Portuguese port at Beira, which could be brought hundreds of miles nearer if the cut-off line from Kafue to Salisbury was laid; it has also Lobito Bay, the terminus of the new Benguella Railway, which joins that port on the Atlantic with the Congo and Rhodesian Railways, thus affording the quickest and cheapest means of reaching Katanga and the Northern Rhodesia copper belt. It serves such important towns as Jadocville, Elizabethville, N'dola, N'Kana, Luanshya, and Broken Hill. Goods imported through Lobito Bay have arrived in N'dola within twenty-four to thirty days from shipment in London, approximately the same time being occupied to Elizabethville. But apart from the greatly reduced period of time in transit, a very important factor is the substantial economies in through cost to destinations in Angola, Katanga, and points in Northern Rhodesia, as far south as Broken Hill, and particularly in the mining areas of N'dola and N'Kana. The advantages of Lobito Bay include the ability of large liners to moor some 30ft. from the shore, thus ensuring rapid dispatch of goods, and there is a regular monthly service of steamers from London to Lobito. There are also steamers from Glasgow, Birkenhead, and Continental ports. A comparison shows that the new route has brought British merchants and manufacturers hundreds of miles nearer, and put them in closer touch with the markets in South Central Africa.

THE old waterworks pumping plant at Trichinopoly, which has a capacity of 1800 gallons a minute, is to be replaced by one of 3000 gallons per minute.

A Large Plano-Milling Machine.

THERE has recently been constructed by Kendall and Gent (1920), Ltd., Manchester, an exceptionally large heavy-duty plano-milling machine, of which we give illustrations herewith and on pages 382 and 387. The makers claim that it is the largest of its type hitherto built in this country, and that it solves the costly problem of resetting the jobs which is frequently necessary when machines less adequately equipped are employed. The large outputs obtained by this machine are due mainly to the universal character of the general motions and to other features, especially on work which enables the simultaneous use of the multiple heads.

The machine has a capacity for dealing with objects 12ft. wide, 8ft. high, and 28ft. long, and is provided with four spindles, two vertical spindles on the cross slide and one on each of the uprights, the left-hand vertical and horizontal spindles being arranged to swivel through an angle of 20 deg. on each side of the centre line. The bed is 53ft. long, of box section, and rests on the foundation throughout its whole length, flat guides being provided which have special troughs to collect surplus lubricating oil from the slides. The table is 12ft. 6in. wide overall, of very deep section, and well ribbed to prevent deflection under heavy loads, and the T slots for holding the work are cut out of the solid. Hand and variable self-acting reversible feed motions are fitted, along with quick-power traverse for setting purposes.

Motion of the table is transmitted by means of long twin worms engaging with semi-circular racks, and the end thrusts are taken up by heavy ball washers. The racks and worms are of iron cast in special moulds, which produce close-grained castings of high tensile strength, and lubrication of the wearing surfaces is provided by means of a pump.

The electrical controls for the table motion are situated on each side of the machine in convenient positions for the operator.

The uprights which carry the cross slide and horizontal saddles are of massive proportions with broad bases resting on the foundation. They are securely bolted to the sides of the bed and are connected at the top by a cross stay. The vertical slides on which the cross slide and saddles move have broad and accurately machined surfaces. The cross slide, which is partly balanced to ensure easy manipulation, is raised by means of a reversible motor mounted on the cross stay at the top of the machine. It is strongly designed to prevent any deflection when the two vertical saddles are working close together in the middle. In order to obviate the possibility of the cross slide becoming out of truth, owing to wear of the elevating screws, the makers have provided a compensating clutch on the horizontal shaft at the top of the machine. The vertical saddles on the cross slide have hand and variable self-acting feed motions, together with means for rapid traversing for setting up purposes, and the controls for these motions are operated from the platform without the operator having to leave the work. As previously mentioned, the left-hand saddle, being arranged to swivel, enables objects having angular faces to be machined without the necessity of resetting. Separate electric motors of 30 horse-power, and having a speed variation of 4 to 1, are provided for the spindles, to which they are coupled direct by steel gearing.

The horizontal saddles on the uprights are balanced and fitted with hand and variable self-acting reversible vertical feed motions, together with means for rapid traversing when setting up work. These saddles may be traversed independently or simultaneously as desired, while the left-hand saddle can be swivelled through 20 deg. on each side of the horizontal.

The main drive is by means of a 60 horse-power, variable-speed motor, situated on the left-hand side of the machine, and having a speed variation of 4 to 1. It is coupled to the right and left-hand saddles by a Texrope drive and substantial shafts and gearing, which are enclosed in a box and amply lubricated.

The spindles are of heat-treated high-tensile steel, and run in adjustable conical gun-metal bearings, the front bearings being carried in a steel sleeve, which is fitted with means of fine adjustment for putting on the cut by means of a worm wheel, rack and pinion. The casting is closed firmly on the sleeve by efficient locking bolts, making the sleeve practically solid with the saddle. For receiving the cutters or mandrels the noses of the spindles have a recess, the drive being effected by flats on the collar, while large face cutters are mounted direct on to the flange on the spindle.

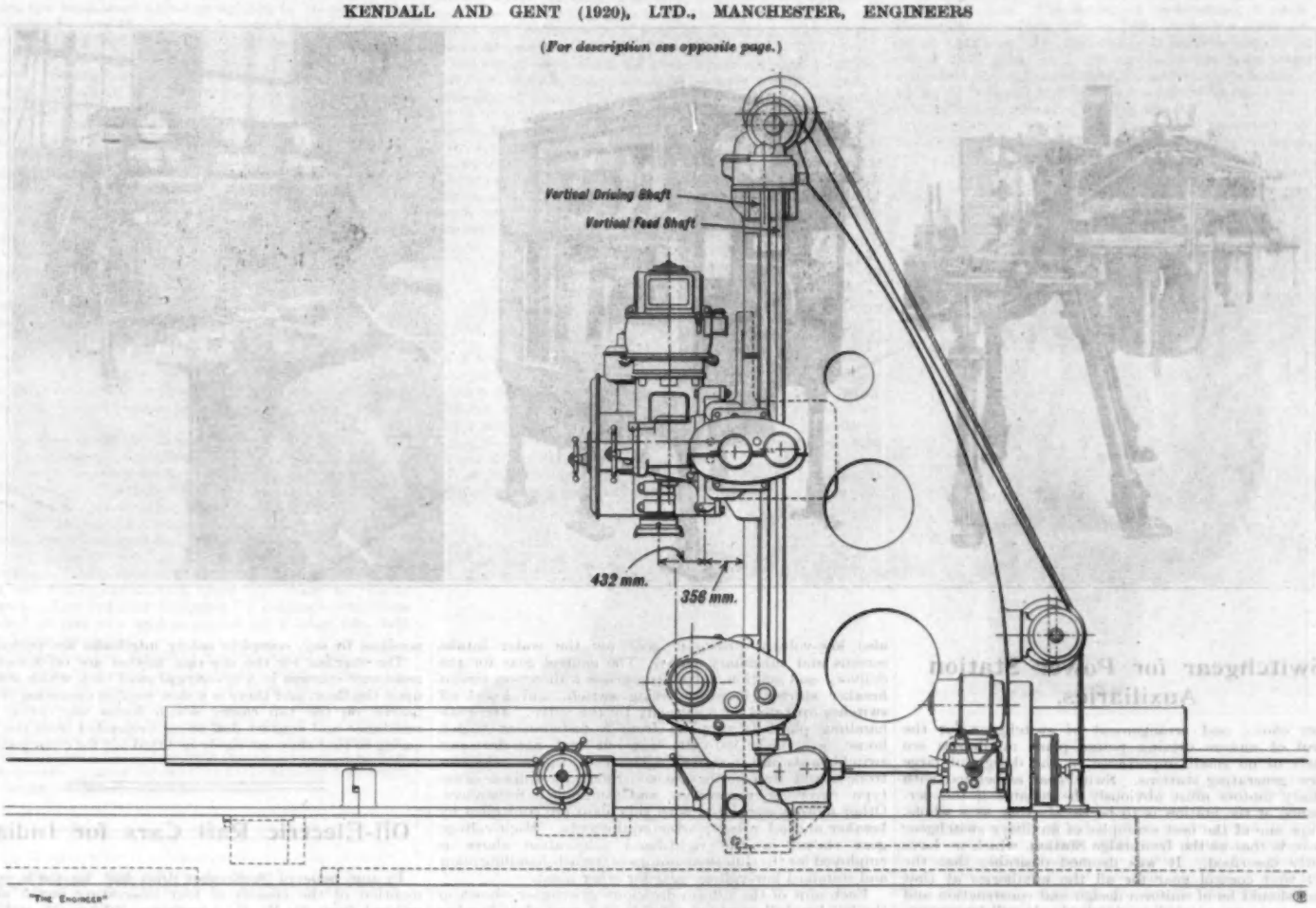
The feed motions to the table and saddles are operated by a 20 horse-power reversible motor and Texrope drive to a gear-box having hardened steel gearing mounted on splined shafts and running in oil, giving nine graduated feeds to each spindle speed. All power feeds and traverse motions may be operated independently or simultaneously by means of conveniently placed levers and push-button switches from the operator's normal working positions on each side of the machine. This arrangement is, of course, essential on a machine of such size to avoid undue fatigue of the operator.

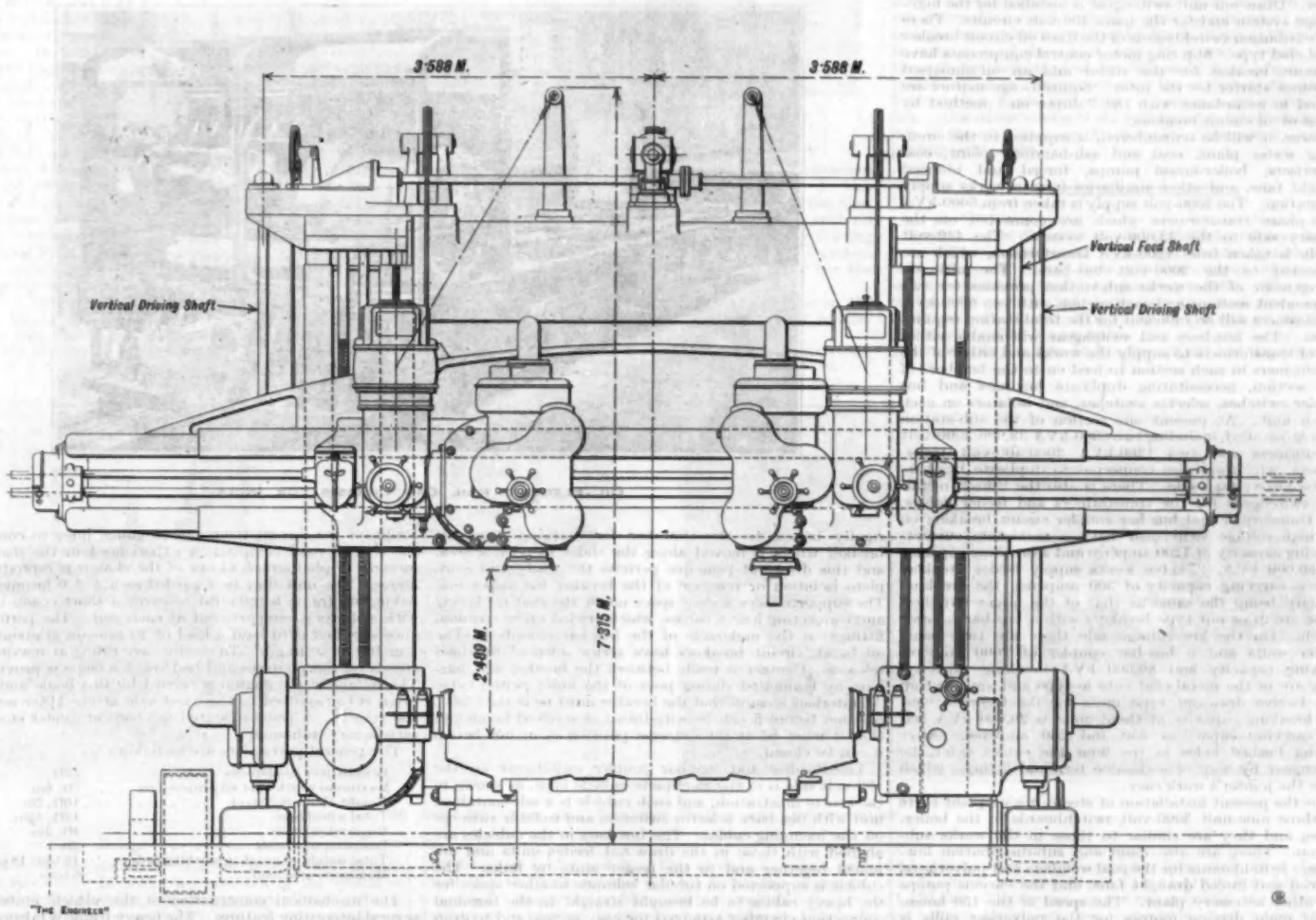
Lubrication of the various parts has been carefully considered, and where possible splash lubrication has been adopted, while elsewhere the Enot "one-shot" system is employed. The electrical equipment was supplied by Metropolitan-Vickers Electrical Company, Ltd. The control panels are of the contactor type, with special interlocking devices which govern the panel control for the feed motor. In the event of any spindle of the machine coming to rest the motor is automatically cut out, thus preventing damage to the milling cutters. It is also impossible to operate the feed motions without first starting the spindle required for the operation in hand. When, however, the table and saddles are required to move for setting purposes, a change-over switch may be operated, enabling these motions to be carried out. The push-button controls are also placed on points most convenient for the operation of the various motions of the machine to enable the operator to start, stop, inch, or reverse every motion from the normal operating position.

GENERAL ARRANGEMENT OF HEAVY-DUTY PLANO-MILLING MACHINE

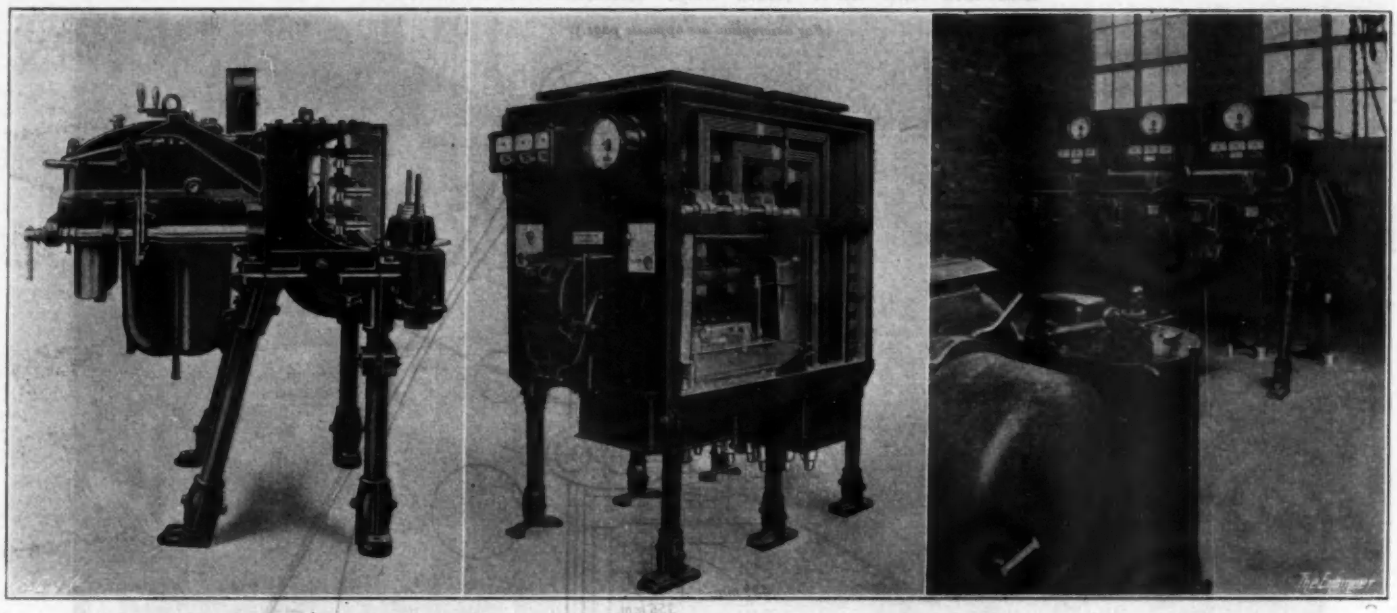
KENDALL AND GENT (1920), LTD., MANCHESTER, ENGINEERS

(For description see opposite page.)





AUXILIARY SWITCHGEAR AT IRONBRIDGE POWER STATION



Switchgear for Power Station Auxiliaries.

The choice and arrangement of switchgear for the control of motors driving power plant auxiliaries are matters of no small importance in the design of large electric generating stations. Switchgear associated with auxiliary motors must obviously be reliable if the performance of the station is to be satisfactory as a whole. Perhaps one of the best examples of auxiliary switchgear practice is that at the Ironbridge Station, which we have recently described. It was deemed desirable that the switch and control gear for all the auxiliaries at that station should be of uniform design and construction and Ellison gear was selected as standard. It will be remembered that there are two works power supplies—three-phase 3000 volts for motors of 75 horse-power and more, and three-phase 400 volts for motors smaller than 75 horse power. Draw-out unit switchgear is installed for the high-voltage system and for the main 400-volt circuits. There are distribution switchboards of the fixed oil circuit breaker metal-clad type. Slip ring motor control equipments have a circuit breaker for the stator and an oil-immersed resistance starter for the rotor. Squirrel-cage motors are started in accordance with the "direct on" method by means of oil circuit breakers.

Power, it will be remembered, is supplied to the circulating water plant, coal and ash-handling plant, coal pulverisers, boiler-house pumps, forced and induced draught fans, and other auxiliaries from a works supply sub-station. The 3000-volt supply is taken from 6000-kVA three-phase transformers which are connected on the primary side to the 33,000-volt system. The 440-volt supply is taken from 1200-kVA transformers, which are connected to the 3000-volt bus-bars. The ultimate arrangement of the works sub-station provides for two independent sections and each section with two 6000-kVA transformers will be sufficient for the total station requirements. The bus-bars and switchgear will enable either pair of transformers to supply the works and either of the transformers in each section to feed on to the bus-bars of that section, necessitating duplicate bus-bars and bus coupler switches, selector switches, and isolators on each switch unit. At present one section of the sub-station plant is installed, including two 6000-kVA 33,000/3000-volt transformers and two 1200-kVA 3000/400-volt transformers, which are also connected to duplicate bus-bars on the low-voltage side. There is also the Ellison metal-clad switchgear for the transformers and feeder cables. The transformer and bus-bar coupler circuit breakers on the high-voltage switchgear have a maximum current-carrying capacity of 1200 ampères and a breaking capacity of 150,000 kVA. Twelve works supply feeder breakers have a carrying capacity of 300 ampères, the breaking capacity being the same as that of the larger switches. These are draw-out type breakers with a bus-bar selector switch. On the low-voltage side there are two transformer units and a bus-bar coupler of 2000 ampères carrying capacity and 80,000 kVA breaking capacity. They are of the metal-clad cubicle type and are lined up with twelve draw-out type units for the feeder cables. The breaking capacity of these units is 26,000 kVA and the carrying capacities 550 and 250 ampères. After leaving bushed holes in the floor the cables enter the switchgear by way of accessible terminal fittings, which made the jointer's work easy.

For the present installation of steam-raising plant there are three nine-unit 3000-volt switchboards in the boiler-house, and they are similar to those in the works sub-station. There are also main and sub-distribution low-voltage switchboards for the coal weighers and pulverisers, induced and forced draught fans, and the various pumps and other accessory plant. The speed of the 150 horse-power main driving motors for the pulveriser mills is regulated by air-cooled rotor resistances operated by pedestal hand wheels on the firing floor.

Three thousand-volt draw-out switchgear and oil-immersed resistance starters are provided in the circulating water pump house for the three 300 horse-power centrifugal pump motors at present installed. There is also low-voltage draw-out gear for the water intake screens and subsidiary plant. The control gear for the delivery and suction valves comprises a direct-on circuit breaker starter, hand reversing switch, and knock-off switches operated automatically by the valve. The coal-handling plant is supplied from a distribution switch house, in which 400-volt draw-out and non-draw-out switchboards are installed. The coal tippler, elevator trolley, and transporter are controlled by Ellison drum type reversing controllers and air-cooled resistances. Other motors associated with this plant are controlled by breaker and oil rotor starter equipments. High-voltage gear shown in the right-hand illustration above is employed for the sluiceway pumps of the ash-handling plant and standard low-voltage gear for other plant.

Each unit of the Ellison draw-out switchgear, shown in the left-hand illustration, consists of a steel plate bus-bar chamber supported on tubular pillars with slide rails rigidly bolted to the chamber for carrying a circuit breaker which is moved along the slides by vice screws, and this draw-out principle permits the ready and complete isolation or removal of the breaker for inspection. The supports leave a clear space under the gear for laying and connecting heavy cables, which are led up to terminal fittings on the underside of the bus-bar chamber. The oil break circuit breakers have series solenoid overload releases. Contact is made between the breaker and bus-bars by laminated sliding jaws of the knife switch type. An interlock ensures that the breaker must be in the "off" position before it can be withdrawn or screwed home and that it must be at the extreme position in or out before it can be closed.

Transformer and bus-bar coupler switchgear on the 400-volt side is of the steel plate cubicle type, as shown in the centre illustration, and each cubicle is a self-contained unit with bus-bars, selector switches, and isolator switches on the incoming cables. The bus-bars in the cubicles are aligned with those in the draw-out feeder units and are joined together and to the feeder units by links. The cubicle is supported on tubular columns to allow space for the heavy cables to be brought straight to the terminal connection chamber arranged for easy access, and to drop the breaker oil tank. The circuit breaker, which has a breaking capacity of 80,000 kVA, is carried on a framework which permits of the removal of the breaker complete with its operating mechanism. The bus-bar selector switches are arranged to connect the breaker to either of the two sets of bus-bars or to isolate the breaker from both, and, needless to say, complete safety interlocks are provided.

The starters for the slip-ring motors are oil-immersed resistance starters in a cylindrical steel tank which stands upon the floor, and there is a slow-motion operating crank handle on the top casing which forms the cover, the resistance and contact dial being suspended from the top casing so that they can easily be lifted out for examination.

Oil-Electric Rail Cars for India.

In our issue of September 16th last we made some mention of the chassis of four interesting power units ordered from Sir W. G. Armstrong, Whitworth and Co. (Engineers), Ltd., by H.H. the Gaekwar's Baroda State Railways for use on their narrow-gauge lines to combat the serious road competition experienced in the district served. A photograph of one of the chassis is reproduced above. The unit may be regarded as a 4–2–0 locomotive having its frame lengthened to carry a short coach body with a driver's compartment at each end. The performance specified is to haul a load of 30 tons on gradients of 1 in 100 at 20 m.p.h. To ensure easy riding at maximum speeds on sharp curves and bad track a bogie is provided. The weight of the engine is carried by this bogie and the drive is transmitted to the fixed axle at the other end of the vehicle. A pedal-operated mechanical sander ensures satisfactory adhesion.

OIL-ELECTRIC RAIL CAR CHASSIS FOR INDIA

The general particulars are as follows :—

Length over headstocks	23ft.
Maximum width over all projections	7ft. 6in.
Height above rail level	10ft. 2in.
Total wheel base	13ft. 4½in.
Bogie wheel base	4ft. 3in.
Diameter of wheels	2ft.
Total weight of coach in working order	12 tons 18 cwt.
Maximum axle load	6 tons

The mechanical construction of the vehicle embodies several interesting features. The heavy frame is fabricated entirely by electric welding and consists of two outer sole-bars with inner members to take the loads imposed by the central couplers and to support the driving motor and the axle-box guides of the driving axle. The bogie is of the type in which the weight of the vehicle is carried on side bearings, supported by spiral springs on the bogie transom,

the pivot being free to rise and fall in a spherical bearing and acting only as a centering device. The bogie side frames are built up with plates on either side of top and bottom channels providing a very stiff arrangement which enables the laminated axle-box springs to be placed and held centrally over the boxes. A considerable amount of electric welding has also been used in the bogie construction.

Power is transmitted from the driving motor by a Hardy Spicer cardan shaft to a worm gear box carried on the driving axle. The gear-box made by Armstrong, Whitworth incorporates a Craven-Guest hollow-face worm and worm wheel, the latter being gripped between two cast steel spiders keyed by splines to the axle. The driving wheels are cone seated and can be readily removed to permit renewal of the worm wheel or bearings. Roller bearings are used on both worm shaft and axle and are well protected against dust. A torque rod attached to the vehicle frame takes up the torque reaction of the gear-box. All wheels are rolled steel discs with the railway's standard tires, and Isothermos axle-boxes are used for all axles. With the exception of the axle-boxes, which require attention only after 100,000 miles of running, Tecalemit grease lubrication is used throughout, the grease nipples being brought out to easily accessible positions. Cowcatchers are fitted at both ends. Wood-built bodies are being made in the railway's workshops in India and will be fitted there. They will have first and second-class compartments and a driver's position at both ends.

The engine is an 80 B.H.P. six-cylinder 1600 r.p.m. Armstrong-Saurer, manufactured in the Armstrong-Saurer Commercial Vehicle Company's works adjoining the Armstrong, Whitworth works at Scotswood-on-Tyne. It drives a D.C. generator and the unit has been mounted under a bonnet across one end of the vehicle frame, where it is very accessible and takes up a minimum of floor space. It is mounted on a three-point "Silent-bloc" rubber suspension. The complete engine-generator unit can be taken out and replaced by a spare unit ready to run in 2½ hours. The radiator designed for tropical conditions is placed at one side and is cooled by a large fan, belt driven from the engine.

The trials on the Manifold Valley line of the L.M.S. Railway were witnessed by Rao Saheb Ram Kishen, the Manager and Engineer-in-Chief of H.H. the Gaekwar's Railways, and by the inspecting engineers, Messrs. Rendel, Palmer and Tritton, as well as by a number of interested officials of home and overseas railways. This sinuous line, with its frequent gradients which rise to 1 in 50 in several places, proved a most interesting and valuable test track upon which to demonstrate the railcar.

Two New Shunting Locomotives.

WE illustrate below two recent designs of oil engine shunting locomotives made by John Fowler and Co. (Leeds), Ltd., of Leeds. One weighs 25½ tons and the other 30 tons, and both are of standard gauge. The lighter model will handle 519 tons and the larger 635 tons on the level when the track and rolling stock resistance is 20 lb. per ton. In both models the cab is placed in the centre, with the engine and clutch at one end and the gear-box, jack shaft, starting engine, and Westinghouse power brake mechanism at the other in order to secure good weight distribution.

In both cases power is provided by a direct-injection, 100 B.H.P. oil engine, having four cylinders of 165 mm. bore and 220 mm. stroke, with a governed maximum speed of 1000 r.p.m. Water circulation is effected by pump and air is drawn through a cowled radiator by a belt-driven fan. Inside the fly-wheel is a multiple-plate clutch, which has a frictional area largely in excess of the calculated requirements.

The pedals and levers respectively for the clutch and fuel pump have been duplicated so that the driver has complete control from any position.

The levers operating the gears are centrally situated, so that they can be reached without trouble.

Behind the clutch is a universally jointed shaft conveying power to the gear-box. Either three or four speeds can be specified. In each case selection of the speeds is by means of dog clutches, and the gears are of the constant-mesh type. From the secondary shaft power is conveyed by bevel to either of two crown wheels. According to which of these two is in engagement, the locomotive travels in one direction or the other. On the lateral shaft carrying the two crown wheels are spur pinions, engaging with corresponding pinions on the jack shaft, and at the extremities of the last named are cranks with bob weights. Power is conveyed from these cranks to the coupled driving wheels by means of long connecting-rods.

The petrol donkey engine, for starting purposes, is carried above the main gear-box, and the drive thereto is by chain. A sliding pinion on the driven shaft of the starter set meshes with a gear on the main shaft of the principal gear-box.

The compressor of the air brake set is operated from the gear-box. On the frame are sand boxes with filling orifices immediately above. When the appropriate control in the cab is operated, sand is supplied to either pair of driving wheels, according to the direction of travel.

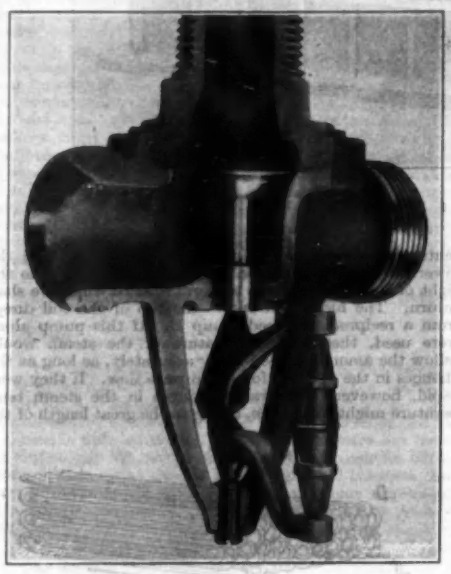
It should be noted that the heavier type of locomotive has coupled driving wheels of 33in. diameter, whilst the lighter pattern has 39in. wheels, and the respective overall heights are 9ft. 8in. and 9ft. 11in. Both have an overall width of 7ft. 6in.; an overall length (over the buffer beams) of 21ft. 8in., and a wheel base of 6ft. 3in.

30 AND 25½-TON OIL-ENGINED SHUNTING LOCOMOTIVES

Oil Fire Extinguishing.

ON a recent occasion we witnessed some demonstrations of a quite new system of extinguishing fires on the surface of tanks filled with various kinds of oil. They were most effective and only involved the use of comparatively simple apparatus and the supply of water. The sponsors of this idea are Mather and Platt, Ltd., of Manchester, and 22, Great Smith-street, Westminster.

It should be explained at the outset that this system is essentially one for situations where fire may be expected,



AUTOMATIC WATER VALVE

and consequently one is justified in installing a permanent arrangement for the extinction of an outbreak. In this category the sprinkler system is, of course, quite familiar, but such arrangements are not adequate to deal with oil fires; they would, in fact, intensify the danger by floating the oil out of bounds. In the case of the Mulsifyre system with which we are dealing, water alone is used, but the danger of spreading is practically non-existent.

The secret of the process lies in the production on the surface of the ignited oil of an emulsion which is non-inflammable.

In an emulsion the oil is broken up into minute particles, each of which is encased by a film of water, so that, provided that the little bubbles are not burst, the oil cannot be ignited. Hence the problem resolves itself into the production on the surface of the oil of an emulsion of that oil itself, with water supplied from outside. This is effected by arranging over the oil tank a network of piping fitted with sprayers at appropriate intervals, one of which we illustrate. The sprayers are a simple ¼in. orifice, directed upwards against a baffle of the Grinnell type. This baffle breaks up the water into fine particles and produces a conical spray which is practically "solid" (not annular). The force of this spray, which is backed by a pressure of from 80 lb. to 100 lb. per square inch, is such that it emulsifies the surface of the oil and produces the desired protecting coat. The force, we understand, is such that the jets may be from 10ft. to 15ft. above the surface of the oil and still be fully effective. It will be readily appreciated that when once the emulsion has been formed it provides, not only a blanket to prevent the access of air to the oil beneath, but also an insulation to check evaporation by the remnants of the fire above.

In order to ensure the automatic operation of the installation a special valve is arranged in the water supply

WATER SPRAYER

to the jets, an illustration of which we also give. This valve is held up on its seating against the water pressure by a toggle system of links, which is completed by a little capsule of quartz glass filled with liquid. Should the surrounding temperature rise beyond any predetermined point, that may range between 135 deg. Fah. and 360 deg. Fah., the capsule explodes, the toggle links collapse, and water is admitted to the spraying jets.

At the demonstrations which we witnessed we were astonished at the rapidity with which a really serious conflagration of either heavy oil or spirit was extinguished, only a matter of two or three seconds passing, even after the automatic valve had been purposely put out of action and the water then turned on by hand. During those few seconds it is obvious that very little water could pass through the nozzles, and we estimated it at about one-hundredth of an inch spread over the surface of the tank. Nevertheless, it was completely effective in quenching the fire. One of the merits of the system is the small adulteration of the oil remaining in the tank by the water used in putting out the fire.

THERE is one direction in which British railways have been able successfully to withstand the competition of road transport. That is in the conveyance of parcels and miscellaneous traffic by passenger train. The gross receipts for parcels during the last six years have been £6,627,507, £7,033,402, £6,935,031, £7,090,085, £7,039,734, £6,747,978. For newspapers the receipts have been £1,697,835, £1,870,503, £2,128,300, £2,227,157, £2,246,001, £2,140,571. The gross receipts from fish have been £1,468,392, £1,524,324, £1,497,751, £1,519,917, £1,549,884, £1,470,640. The figures suggest not only that the railways are holding their own, but, considering bad trade, that they have improved their position. The newspaper traffic returns are rather instructive and make one wonder why that particular traffic has grown. May we suggest that it is mainly due to the absorption of the papers published in provincial towns by combines that cover a wide area?

MODEL OF SULZER SINGLE TUBE STEAM BOILER

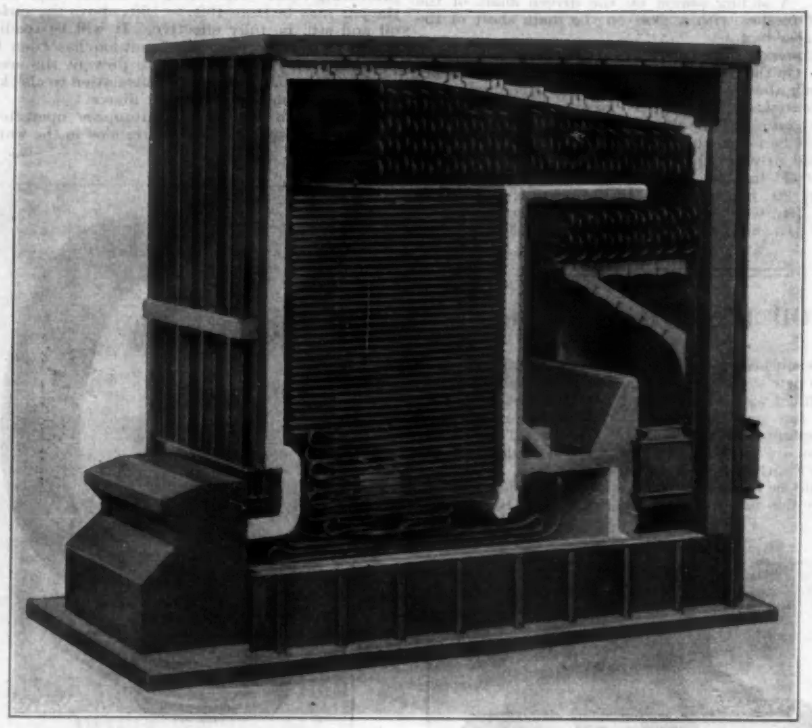


FIG. 1

A Remarkable Steam Generator.

VERY rarely do we find it advisable to offer our readers descriptions of new inventions and designs before they have been actually tested on a reasonably large scale, but we think a justifiable exception is presented by a type of steam generator which Messrs. Sulzer Brothers, of Winterthur, are now constructing after two years' tests with an experimental plant. When we say that such a generator, with, for example, an output of 20,000 lb. of steam per hour, will have a continuous steel tube about 2in. in diameter and no less than 1½ miles long, we shall excite the interest of our readers.

A steam generator of this type at present under erection in a textile works will have a normal output of 18,000 lb. per hour at a pressure of 1400 lb. per square inch, and will supply steam to a high-pressure turbine, the exhaust from which is employed for heating the buildings and for process work (dyeing, bleaching, &c.). Professor Stodola is taking a great interest in this steam generator, and as soon as it is completed will begin a series of exhaustive tests. A larger generator, about 40,000 lb. per hour evaporation, is also being made for a district heating plant in Zürich. The high-pressure steam from this generator will also go to steam turbines, and the exhaust from these turbines will be employed for heating the numerous buildings of the Federal Technical University, a hospital, and neighbouring quarters. A model of the generator is shown in Fig. 1, and the tube arrangement in Fig. 3. In Fig. 1 the mechanical stoker is indicated by the block on the left side. The rectangular coil immediately following it is the combustion chamber, F in Fig. 3. This coil is only one tube thick and forms the superheater, the steam being delivered at its summit, as shown at B, Fig. 3. Rising from the combustion chamber the hot gases pass successively through groups E D C, and pass to the uptake through an outlet on the right, depositing soot, &c., in the trough seen in section in the model. In order to prevent the tubes sagging together, they are separated by distance pieces welded on at intervals. The feed, already heated, enters the tube at A in contra flow to the hot gases. Messrs. Sulzers are satisfied that in a short time it is converted into a froth which gradually becomes dry superheated steam, and in that form issues at a high velocity at B. In the actual plant it will directly enter the steam main of the turbine. No separator is used.

Since it is impossible to produce a steel tube, 2in. in diameter and 1½ miles long, the separate lengths have to be welded together in the same manner as in the manufacture of ordinary superheater tubes. The process, which has been carefully worked out, leaves a smooth internal surface.

The question as to "What is to be done in the case of local failure of the tube?" is certain to arise. The answer is that a length can be cut out and a new length welded in in any part. It will be noticed that all the bends are accessible, as in the ordinary type of superheater, and Messrs. Sulzer are so satisfied that repairs to any part of the boiler can be quickly effected that they are ready to guarantee the replacement within a reasonable time limit of any part of the tube.

Owing to the fact that there is no reserve of water in generators of this general type, it is usual to control the feed supply by appropriate apparatus. When the fuel is oil, the burners are also controlled. That cannot be so readily done in the present instance, since the boilers in question will be coal fired, but the control apparatus will regulate the speed of the automatic stokers and operate dampers. Furthermore, in the case of a sudden cessation of demand for steam, the tube will be at once flooded with water to prevent overheating.

The feed control apparatus is shown diagrammatically by Fig. 2. Here the upper part of the dark coil A represents the economiser and the generator proper, and the lower part the superheater. The looped extension to the right of the superheater is a thermostat to which we shall return. The main feed enters the top of the coil direct from a reciprocating feed pump B. If this pump alone were used, then the temperature of the steam would follow the amount of feed fairly accurately, as long as the changes in the demand for steam were slow. If they were rapid, however, undesirable changes in the steam temperature might take place, owing to the great length of the tube. To prevent such changes, a small quantity of feed is delivered into the superheater through the valve H. Both supplies are regulated by the temperature control valve D, whilst the pressure of the steam is regulated by a delivery valve.

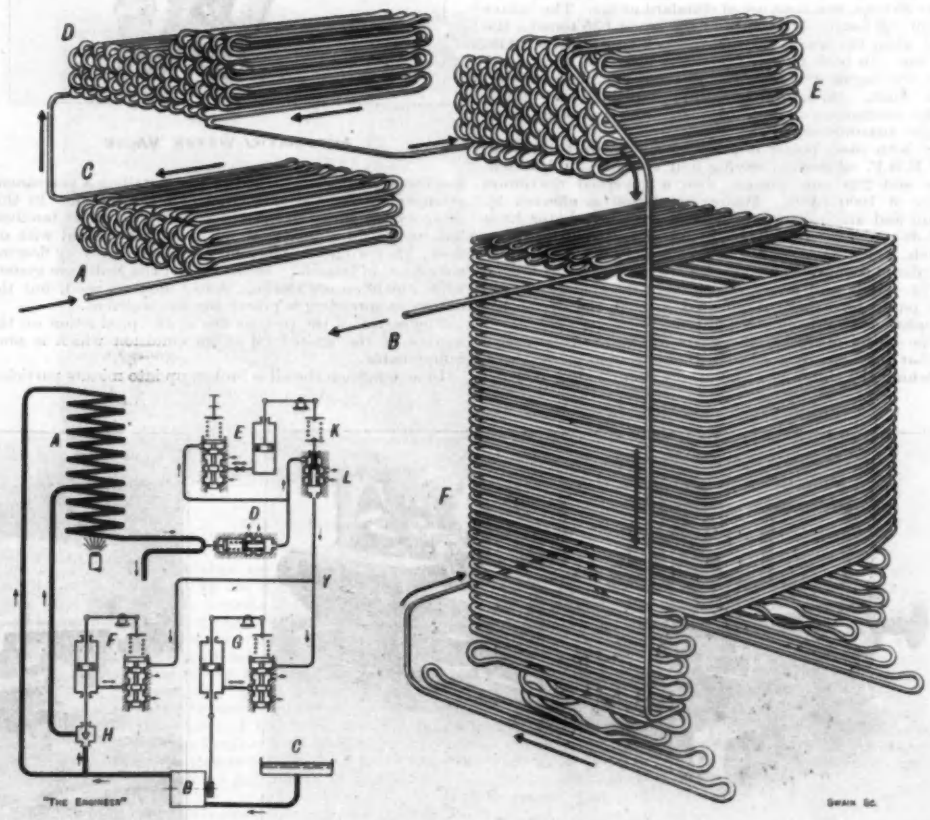


FIG. 3

FIG. 2

The thermostat operates the temperature-regulating valve D, which operates the valve L, which, in its turn, controls the pressure in the branched pipe Y. This pressure controls two servo-motors, one of which governs the speed of the feed pump B, whilst the other opens, more or less, the valve H in the secondary feed pipe. In consequence of the pressure of the springs in the control valves of the servo-motors being greater when the servo-motor piston is in the top position than when it is in the lower position, *i.e.*, when raising steam at a high rate, the temperature would become higher than when raising steam at a low rate. To get over this difficulty, a third servo-motor E is employed. This servo-motor is controlled from the temperature regulator D, and, as shown in the diagram, it increases or diminishes the load on the spring K. Now the control valve of the servo-motor E is in its central position only when the steam is at normal temperature. At any other temperature it moves, causing the piston of the servo-motor to move and to increase or diminish the pressure on the spring K. This alters the position of the valve L until the supply of primary and secondary feed is just sufficient to keep the temperature of the steam at the normal.

Tests carried out during two years with an experimental generator capable of raising 8000 lb. of steam per hour, showed that this system of feed and temperature regulation worked excellently.

We may fitly conclude this brief description of a generator which is certain to arouse much interest amongst engineers with Messrs. Sulzer Brothers' own statement of the considerations which influenced its design :—

(1) In order to avoid steam bubbles clinging to the tube walls, the speed at which the working medium flows through the generator is increased. To be certain of obtaining sufficient speed at every point, the generator is constructed as a single tube of great length, the feed being pumped into one end and the steam issuing in a superheated state from the other. On account of the positive flow, it is absolutely impossible for the steam to remain stationary anywhere; the mixture of water and steam hurries as a froth through the tube in the evaporating zone. Also, in consequence of the positive flow, it is unnecessary to take any of the precautions previously required for ensuring circulation in the tube, which is led in many coils through the hot flue gases. Consequently it is possible to meet the special requirements of any particular case.

(2) In principle, condensate is used for feeding the generator, since all experience made with the former high-pressure boilers has shown that the use of condensate is the most certain way to avoid deposits forming on the tubes.

(3) Since the generator is constructed as a single continuous tube, expensive boiler drums are eliminated. The storage capacity is, however, low, and measures had therefore to be taken so that the rate of evaporation should be rapid enough to suit fluctuations in service conditions. This is effected by adopting completely automatic regulating devices, which keep the steam pressure and temperature always approximately constant, and regulate the quantity of feed to comply with the heat of the furnace. According to circumstances, the firing is also automatically regulated; for example, in accordance with the pressure in the steam pipes, or in plants with low-pressure steam storage, in accordance with the pressure at which the steam is stored. Through the regulating apparatus, which is connected with automatic safety devices, attendance on the generator is greatly simplified, consisting only in superintending the regulating devices.

THE FINSBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION proposes to hold a series of informal and inexpensive dinners during the next six months to enable old students to "get together." The hon. secretary is Mr. F. R. C. Rouse, of Venner Time Switches, Ltd., New Malden, Surrey, and 15, Clifton-gardens, Golders Green, N.W.11.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Autumn Quarterly Meeting.

There was a large and representative gathering of iron and steel producers and consumers on 'Change in Birmingham to-day—Thursday—on the occasion of the autumn quarterly meeting of the Midland iron trade. Though in tone the gathering showed improvement and though it was asserted that the past three months had produced more business in some branches than the months intervening between the spring and summer quarterly meetings, transactions to-day—at any rate up to the time of writing—were not up to expectations. It cannot be said that manufacturers had placed their anticipations on a high level. Indeed, they were recognised by consumers to be quite moderate, yet the latter did not see their way clear to commit themselves to the extent iron and steel masters had hoped for. The possibilities of business between now and the end of the year were freely discussed, and while there were a few outstanding instances such as steel for the automobile makers and foundry iron for the light castings industry, generally manufacturers were able to furnish little solid ground on which to build hopes of definite progress in consumptive demand over that period. Midland structural engineers expressed doubt as to their ability to take as much finished steel as of late. Rolling stock establishments are gradually becoming worse off for contracts. Heavy engineering firms see no perceptible upward movement in trade, and chain and anchor makers are sparsely engaged, as are edge tool, tube and other heavy Midland industries. Trade expansion is, however, apparent in the lighter branches, which cover a wide range of products, while the steady improvement in the automobile, heavy, and light electrical, the pump, the light foundry, and the hardware and hollow-ware trades help to brighten the situation. At to-day's meeting there was little change from the general run of buying, tonnages of iron and steel being restricted for the most part to a safe level. Consumers are afraid to buy in advance of known needs, and efforts to induce them to return to a policy of contracting forward have met with little success. It is unfortunate to have to record that, according to the data collected for the Midland Iron and Steel Wages Board, the trade turnover in July and August was the smallest the district has known since the summer of 1928. The average price was not maintained, but the fall was insufficient to affect the rate of wages, which remains at 22½ per cent. above the basis of 13s. 6d. for puddling. Happily, since August the demand for some products has shown a growing tendency, and it is confidently hoped that September and October figures will present a better appearance. It is reported on 'Change that consumers of iron and steel at the quarterly meeting took slightly more interest in the renewal of supplies, and in a number of instances stocks at the works are to be brought up to more like the normal level. Buyers displayed little interest in the chances of a realignment of steel prices. The present basis has been in existence for a considerable time, but it is hardly likely that existing prices are interfering materially with the volume of business being done. Visible consumptive requirements are small, and probably the majority of the large users are participants in the rebate scheme, which ensures their placing their orders with native steelmasters. In the finished iron trade, prospects are held to be poor, but in the raw iron industry Midland blast-furnacemen report better buying of foundry material, though plant is not regularly engaged. The outlook on the whole remains clouded, and producers and consumers alike will have to await the gradual unfolding of the trade situation. There is no actual reliance upon industrial development in this area, but confidence is sustained, and although manufacturers are perplexed they are not discouraged. They are determined to contest every inch of ground and to restore their own particular section of industry to its normal position of prosperity. Things are, they believe, moving in the right direction, though very slowly, and they have faith in their own ability, if given a fighting chance.

Steel.

Users of finished steel on 'Change to-day were unable to enlighten producers as to their probable requirements to the end of the quarter. The outlook for the majority of them, whether engaged in structural or general engineering, is unsettled, being regulated by forces and considerations beyond their control. There are no established evidences upon which to base conclusions, and though they expect business to loom up out of the fog, as it were, they cannot visualise its bulk or the time of its appearance. Under these circumstances, it is not surprising that steelmasters added little to their order books at a result of the quarterly gathering of consumers. The tonnages changing hands are light, and relate to current requirements. The Steelmasters' Association is considering the question of selling rates for finished material, but up to the time of writing quotations were unchanged. For angles, £8 7s. 6d. was asked; tees were £9 7s. 6d.; joists, £8 15s.; and ship, bridge, and tank plates, £8 17s. 6d. —all per ton, less rebate to users of British steel only. Boiler plates, prices of which are not controlled, command from £8 7s. 6d. to £8 10s. Makers of steel semis anticipate better business as consumptive demand increases, and existing stocks of foreign material diminish. Continental material prices remain relatively high and firm, and if this continues it is quite probable orders which have of late been placed abroad will not be renewed, but will find their way to local steel works. Already some small orders have been received which normally would have gone abroad. Midland steelmasters have made no alteration in their quotations. Re-rollers ask £6 7s. 6d. to £6 10s. for re-rolled bars and £7 for all-British bars; billets are sold at from £4 17s. 6d. to £5 7s. 6d. according to grade; sheet bars made £4 15s.; and Staffordshire hoops, £9 10s.

Pig Iron.

Midland blast-furnacemen report a continuance of the improvement in demand for foundry material. The general volume of trade, however, is insufficient to keep furnaces regularly employed. Moreover, business is not evenly distributed, and while some furnaces are relatively busy, others are slack. Specifications coming to hand indicate that activities at some of the foundries are restricted. Engineering foundries are not so well placed by any means as the light castings branch, and were it not for the demand from this latter quarter, smelters would be in a difficult position. At date the output of pig iron is more than sufficient for current needs, and stocks are being further added to. There was little or no disposition this week to place fresh contracts to cover the current quarter, consumers being content to continue a policy of hand-to-mouth buying. Selling prices are as fixed by the Central Pig Iron Producers' Association: —Derbyshire and South Staffordshire No. 3 foundry is £3 6s.; forge, £3 1s.; Northamptonshire foundry, £3 2s. 6d.; and forge, £2 17s. 6d., delivered stations in the Black Country.

Staffordshire Bar Iron.

Demand for finished iron is hesitating, but there are still instances of Staffordshire makers of marked bars who are operating on a fairly regular basis. For the most part the struggle for orders continues throughout all the branches of the wrought iron trade. The quarterly meeting produced nothing of importance in the way of business, neither did it help to elucidate the mystery of the future trend of trade. The consuming industries need to make a forward move before there can be much hope for the ironmaster. In this connection it is something to be able to record that the tube works in this area are slightly busier, and this past week there has been a better tone in the strip market. Inquiries are in circulation, which encourage makers to hope for additional orders in the near future. Marked bars are in constant, if quiet, request for certain engineering works, and prices are upheld at £12 per ton. Crown bar makers have to compete with makers from other districts for their orders, and as Staffordshire bars are considerably dearer than those of other makes, it is difficult, even with a superior article, to get enough work to keep the mills employed. Common bars are in poor call, the nut and bolt and the fencing industries drawing the greater part of their supplies from abroad. Belgian prices are well below the £7 15s. to £8 quotations of native ironmasters for fencing and bolt and nut iron respectively. Wrought iron gas tube strip continues to be sold at £10 7s. 6d. to £10 10s. per ton delivered.

Sheets.

There is no change on the week in the position of the sheet market. Makers are holding to the new basis of £10 for galvanised sheets of 24 gauge, £8 5s. for close annealed black sheets, £8 17s. 6d. for 26, and £9 5s. for 28. Business is difficult at the moment, consumers not being content to pay the new prices without a struggle for better terms. Mills could well do with additional business, but they hesitate to grant concessions, previous experience of a free selling market not being satisfactory from a profit point of view.

The Anchor Industry.

The new President of the Staffordshire Iron and Steel Institute, Mr. A. E. Osborn (N. Hingley and Sons, Ltd., Netherton), in his presidential address at the opening meeting of the session of the Institute at Dudley, described the development of shipping with particular reference to anchors. Mr. Osborn said that the manufacture of anchors was essentially an industry of Dudley and the surrounding district. Within a radius of 10 miles of Dudley anchors, cables, and chains, ships' and boats' tackle, stern frames, propeller shafts, ships' davits, buoys, lighthouses, and a very large variety of products of the non-ferrous industries were manufactured, which meant that any depression in shipbuilding had a repercussion in the Black Country. Anchor-making was a distinctive South Staffordshire industry. There was no very startling increase in the size and weight of anchors during the greater part of the nineteenth century. The development that took place was rather one of design. The year 1888 saw the introduction of the modern type of stockless anchor, known as Hall's type. Other makes of anchor had been evolved by modification of the design, though not of the mechanical principle, but Hall's anchor still remained one of the most popular type in use by the mercantile marine. Stockless anchors up to 16 tons in weight were supplied to the largest liners afloat.

New Waterworks.

Wolverhampton's new waterworks at Dimmingsdale, erected at a cost of £82,400, were formally opened by the Mayor on Monday. The Corporation now has three water supply works, which serve a population of 193,300. The total length of service and pumping mains in the undertaking is 288 miles, and the average daily consumption of water last year was 4,836,000 gallons. The new works are capable of pumping 3,000,000 gallons of water every twenty-four hours. The two bore-holes are 1025ft. deep, and are lined with steel tubes to a depth of 250ft. The buildings are of reinforced concrete. A slow-speed steam pumping plant, with a vertical triple-expansion engine, has been installed, as being more economical than either oil or electricity. It can raise water from a maximum depth of 250ft. below ground, and pump it 360ft. above ground level, the total lift therefore being 610ft. A horizontal steam turbine pump, with half the capacity of the main engine, has been installed as a stand-by. Other equipment includes three electrical generators, two water-tube boilers, and mechanical chain grate stokers. It is of special interest to note that the machinery is supported on massive concrete beds, and in order to prevent the transmission of vibration or shock, these beds are nowhere in direct contact with the building itself, isolation gaps filled with rubber buffer strips being provided at the floor level.

To Assist West Bromwich Industry.

In presenting to the West Bromwich Town Council the report of the Electricity Committee, which included a recommendation to reduce the charges for current, mainly to industrial consumers, Alderman Bell mentioned that there was an increase of 17 per cent. in the output for September. This was a record figure, and he hoped it was a sign of a revival in trade. In making the concessions in price, he said, the Committee was pledging its prospective profit to its customers, although the industrial outlook this year was so uncertain. It was doing so in the hope that it would help business, and also that a reduced tariff would tend to an increased output. Alderman Bell added that the Committee was hopeful of being able to make further concessions to the larger consumers before long.

Cast Iron Research.

Mr. J. G. Pearce, director of the British Cast Iron Research Association, on Friday evening last delivered his presidential address to the Birmingham, Coventry, and West Midlands Branch of the Institute of British Foundrymen at Birmingham. Mr. Pearce referred to the recent International Foundry Congress, which he attended in Paris, and spoke of conditions in France and Germany, stressing the importance of adequate statistical knowledge for the industry.

Metallurgical Society.

The opening meeting of the Birmingham Metallurgical Society's new session was held at the University on the 6th inst. Mr. W. F. Bragener, last session's President, was in the chair, and presented the Society's Medal and books to Mr. R. J. Brown, a student, for his paper on "The Microscope in Automobile Engine Production." The new President, Mr. A. A. Jude, delivered an interesting address.

Contracts Received.

Among the further recent orders placed by Arcos, Ltd., on behalf of the U.S.S.R., the following are reported:—Compressors, £5000, Bellies and Morcom, Ltd., Birmingham; petrol pumps, A. C. Sphinx Sparking Plug Company, Ltd., Birmingham. The contract for 201 four-wheeled goods wagons of the Indian railways standard type (175 covered type "C" and 26 open type "O"), for service on the Nizam's Guaranteed State Railways, has been awarded to the Metropolitan-Cammell Carriage Wagon and Finance Company, Ltd., of Saltley. The contracts for nuts and washers, weighing approximately 270 tons, required in connection with steel sleepers for the Union of South Africa Railways and Harbour Administration, has been awarded to Nuts and Bolts (Darlaston), Ltd., Darlaston.

Unemployment.

The Midlands area shows up very well in the Ministry of Labour's statistics of unemployment for the month of September, and the general trend of trade in this area leads one to believe that the progress will be maintained during the current month. The numbers of unemployed persons on the registers in the Midlands division on September 26th were 255,477 wholly unemployed, 141,740 temporarily stopped, and 649 normally in casual employment, making a total of 397,866. This was 5226 fewer than the number on the register on August 22nd, and 20,382 fewer than a year before. The total on September 26th comprised 321,575 men, 10,070 boys, 60,348 women, and 5873 girls.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

New Machinery for Old.

To no small extent the troubles of Lancashire textile machinery manufacturers during recent years have been directly due to the vicissitudes of the domestic cotton industry, for the home market for plant was always the textile machinists' biggest field. The closing down of cotton mills has necessarily curtailed the market for replacements, and the financial troubles of the majority of the remainder have been reflected in no uncertain manner upon expenditure on machinery. The effect on Lancashire textile engineers has been little short of disastrous, and a natural result has been the concentration upon overseas outlets, with increased competition resulting in the available business being secured at prices which have tended to become less and less remunerative. The probability is, however, that the policy of economising on new equipment has hit the cotton textile industry itself very severely and is one of the primary causes of its present troubles, or, put in another way, one of the reasons why it is finding emergence from those troubles so difficult a process. The theory is not a new one and from time to time emphasis has been placed upon it by authorities inside the cotton trade itself. During the week-end, Mr. J. A. Ormerod, a former president of the Blackburn Chamber of Commerce, stated that the machinery which India and other textile manufacturing countries is employing, largely the product of Lancashire engineering shops, is far in advance of what Lancashire herself is using, and that if mills here spent money on the renewal of plant they might be in a position to tap markets for new cloth productions to replace the outlets for the lower grade goods which, in consequence of manufacturing developments in overseas countries, appear now to be definitely lost.

Russian Orders.

Apart from some fairly substantial orders for electrical equipment, Lancashire engineering concerns have not so far booked much Russian business since the Government Export Credits Guarantee Department

recently decided to extend the period over which credit facilities in connection with Russian orders would operate. A number of firms in the district, however, are hopeful of securing new business in the near future, more especially in connection with machine tools, although there is a feeling that the delay which occurred before the Government decision was arrived at may have resulted in a number of orders being lost to British engineers.

Mersey Tunnel Tolls.

In conjunction with the Birkenhead Town Council, Liverpool City Council has now agreed to promote a Parliamentary Bill which seeks to give powers to extend the period of toll collection from twenty-five to forty years. The object of this step is to meet the extra cost of constructing the new Mersey tunnel from Liverpool to Birkenhead, and thus limit the rate contribution of Liverpool to 5½d. in the pound. News of the estimated deficit of £1,500,000 was made known in February of this year. The original estimated cost of construction was £5,000,000, but this figure was subsequently increased to £5,222,000. The additional £1,500,000 which is the subject of the Parliamentary Bill will bring the total cost to £6,722,000. Of the extra expenditure nearly £1,000,000 arises from the additional cost of ventilation works.

Non-ferrous Metals.

Pronounced weakness has been in evidence in all sections of the non-ferrous metals market during the past week, with spelter rather less affected relatively than the other metals. Bearish American influences have had much to do with the setback in both copper and tin, more especially in the former, and speculators have been disposing of their holdings freely. Under the pressure of liquidation standard brands of copper have been persistently easy, the loss on balance for the week being in the neighbourhood of £1 10s. per ton. Apart from some buying of refined descriptions for the cable-making industry, the trade demand this week has been very moderate. Unsatisfactory statistical news, coupled with the adverse American influences already referred to and the restricted buying interest, contributed to the weakness in tin, the metal being nearly £2 per ton cheaper than it was a week ago. The trade demand for lead has shown little improvement, and the rather substantial decline of about 15s. per ton has brought current values back to where they were seven weeks ago. Spelter has been more affected by the unfavourable conditions in other sections than by any inherent weakness in the metal itself, for in spite of a fairly active demand for spelter, prices have eased to the extent of 7s. 6d. to 10s. per ton.

Iron and Steel.

Conditions on the iron and steel markets have been interesting enough in some respects, although not much in the way of trade improvement has occurred. In the steel section rumours were prevalent on the Manchester Royal Exchange on Tuesday of the probability of reduced prices for certain varieties of heavy steel as the result of the meeting of the Steel Association this week, but selling interests regarded any movement in this direction as unlikely. For the time being, the demand for steel generally is on a restricted scale, especially in the structural branch, with a slow inquiry reported for special alloy steels from machine tool makers, textile machinists, and the motor trade. The undertone in the case of small re-rolled bars is firmer, although at £6 15s. to £7 per ton prices have not actually changed. Acid and basic boiler plates are quoted at about £8 10s. per ton, with joists at £8 15s., sections at £8 7s. 6d., large diameter bars at £9 7s. 6d., and ship and tank plates at £8 17s. 6d. Quotations for Continental steel products, both finished and semi-finished, are showing an advancing tendency, and the demand is quiet. There is a widespread opinion that a further increase in the tariff, which is deemed to be not unlikely, will effectively put an end to business in many varieties of foreign steel, for the price advantage which Continental makers now enjoy is very much smaller than it was not long ago. There has been little improvement in the volume of contract buying experienced by Midland foundry iron makers, and the demand is on a strictly near delivery basis. Specifications against contracts already on makers' books are about maintained at their recent aggregate level. Finished iron prices are steady, while the demand in this section, as well as for iron and steel forgings, is on a quiet scale.

BARROW-IN-FURNESS.

Hematite.

There is a slightly better tone in the hematite pig iron trade, and the fact that stocks have been reduced so far that the Millom Company has put another furnace in commission proves that trade is a little better. Still, there will have to be considerable improvement before business can be called good. There might be further increases in production if buyers were keener to take delivery of iron awaiting their orders. Business is mostly on home account and there is no evidence of either Colonial or foreign trade expanding as yet, but there are hopes that there will be signs of this ere long. Business with the Continent is still very quiet. The putting in of another furnace improves the demand for iron ore, and there is plenty on the surface as far as native sorts to meet requirements. Foreign ore is still in restricted demand. The steel market is dull and few orders are available, but the rail mills at Barrow continue to work, as also do the small section and hoop departments. Fuel is in fair demand.

Shipbuilding and Engineering.

Commander Craven, the managing director of the Vickers-Armstrong works at Barrow, had, on the occasion of a statement the other day, no fresh news of any further orders for Barrow, but he was able to state that the present number of employees, which is just over 9000, would be kept engaged through the winter. This is satisfactory news, considering the state of shipbuilding and engineering elsewhere.

SHEFFIELD.

(From our own Correspondent.)

Local Steel Trade Conditions.

Although there is a general feeling of confidence that improved conditions of trade are likely to develop and continue, some unsatisfactory features of the Sheffield position are still noticeable. For instance, the heavy steel branches of the big works are still running considerably below capacity, and the tendency is for unemployment to increase. It is stated that on the whole, production increased during September, but at several important works output declined. Improvements were principally in the Siemens departments. As a result of these "patchy" conditions, it is impossible to generalise on the state of trade, but it may be said that confidence is not lacking among local industrialists.

Output Statistics.

As mentioned, increased production during September is reported, but the official figures for August, just available, show that there was ample room for improvement. Output of steel in the area of which Sheffield is the main part amounted to 56,900 tons in August, and this figure may be compared with 75,000 tons in the previous month, and 67,900 tons in August last year. Of the latest total 31,300 tons were basic and 15,300 tons acid quality. In Lincolnshire in August production of steel amounted to 29,500 tons, comparing with 42,900 tons in July and 22,100 tons in August last year. Lincolnshire also produced 35,600 tons of pig iron, compared with 43,300 tons in July and 30,800 tons in August last year.

Trade with Russia.

Following upon the valuable orders placed in Sheffield by the Russian Government and reported last week, it is possible to refer to more work for Sheffield from the same source. This work includes an order for Jonas and Colvers, Novo Steel Works, Sheffield, for high-speed steels valued at £8000. Hadfields, Ltd., has also secured an order and Sheffield is directly interested in the Russian contract for electrical plant valued at £200,000, which has been obtained by Metro-Vickers, of Trafford Park, Manchester, as the heavy forgings, &c., for this contract will be made at the Vickers Works, Sheffield, of the English Steel Corporation, Ltd. In view of these orders, special interest is taken locally in the news of the construction of a new metallurgical works near Tula, Russia, which is said to be going ahead rapidly, ready for the first blast-furnace to be in operation by January 1st, and the second by April 1st. These works, it is stated, will consist of seven blast-furnaces, a coke and by-product works, a Siemens steel plant with an output of 850,000 tons of iron, a pipe foundry, and a power station with an output of 50,000 kilowatts.

Stainless Steel Progress.

Advantages of stainless steel are becoming more widely recognised, and its application to new uses is extensive. Consequently, Sheffield manufacturers are experiencing a fairly good and improving trade. It is hoped that substantial orders will come to the city as a result of important tests now being made by a shipping company on a vessel sailing between this country and Australia. These tests are being made with a view to proving the efficiency of stainless steel for marine purposes, and on the boat are all kinds of stainless steel articles, such as deck fittings, nuts, bolts, rivets, furniture, and cutlery. Mr. F. C. Fairholme, chairman of the Firth-Brearley Stainless Steel Syndicate, Ltd., points out that already on many occasions the efficiency of stainless steel for marine purposes has been proved. This steel is not to be confused with the early stainless steel which was a hard steel for cutlery. It is a chromium-nickel steel, which is soft and ductile, and similar stainless steel has been proved suitable for fittings in railways, coaches, tramcars, &c.

Finished Trades Position.

During August there was an improvement of business in the local cutlery, plate and tool trades, but since then there has been a substantial decline in trade. The buying for the Christmas markets has not yet begun in any substantial way, and it is feared that it will be poorer than last year. Exports to Australia and to other Dominions have increased considerably recently. In Australia the removal of the embargo on silver and plated hollow-ware has resulted in more business coming here. There is a good business being done in spoons and forks, scissors, safety razors, twist drills, mechanics' small tools, hacksaws, and permanent magnets, but competition in most of these articles is very keen, and prices have been cut very severely. A considerable amount of work is being created locally by orders for tools for the British automobile industry, which also, of course, consumes a great amount of Sheffield steel.

Coalfield Purchase.

It is announced that the Sheffield Coal Company, Ltd., has completed negotiations for the purchase of a very large coalfield, running into many acres, which it formerly had under lease from Earl Manvers. This company has recently sunk a new shaft at Brookhouse, and has put down what is claimed to be the most modern coke oven and by-product plant existing in this country at the present time.

Sewage Works Scheme.

In connection with the proposal of the Wakefield Corporation to proceed with a scheme of improvements at the Calder Vale sewage disposal works, at a cost of £78,000, it is interesting to recall similar proposals which were put forward in 1922. At that time there was an inquiry into an application for sanction to borrow £88,000 for the improvement of the sewage works, and a scheme was approved, but a hitch occurred when the Corporation was informed by the mining engineers, Messrs. Greaves and Greaves, that there was a serious fault in the Silkstone seam below the sewage works, and that some years must elapse before the anticipated subsidence could take place. It is now reported that the subsidence has actually occurred, and it is proposed therefore to complete the scheme and provide satisfactory works which will enable the Corporation to turn out an effluent which will meet the requirements of the West Riding Rivers Board.

NORTH OF ENGLAND.

(From our own Correspondents.)

Trade Conditions.

It is somewhat curious that, with Continental values of iron and steel rising, the condition of the North of England iron and steel industries generally shows a decline rather than an improvement. At most of the works it is reported that bookings have fallen off, and also that inquiries are less numerous than they were a few weeks ago. As this is a period of the year when increase of business is expected, the situation is disappointing. It is also disquieting to note that a further shipment of 13,000 sheet bars from Belgium was discharged in the Tees this week. The question of the revision this month of the iron and steel import duties is exciting some interest among manufacturers in this area. It is urged that the advantage of Protection has been largely discounted by the fall in gold prices, and that the temporary character of the duties has a prejudicial effect on business.

Cleveland Iron Trade.

There is no new feature of moment in the Cleveland pig iron trade. The output is now very limited, but it is not all passing into consumption, and makers view with apprehension any increase in stocks. Offers of iron at very low rates to Scottish consumers do not attract much business, and local consumers are not in a position to buy more than small prompt lots. Official quotations are unchanged, No. 1 Cleveland foundry iron being 61s.; No. 3 G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; and No. 4 forge, 57s.

Hematite Pig Iron.

The pressure of heavy stocks is forcing down quotations for East Coast hematite pig iron to unremunerative levels. A drop of 1s. per ton this week in the market quotation for mixed numbers brings the figure down to 59s., but merchants are cutting below this price and yet fail to interest foreign buyers.

Iron-making Materials.

Foreign ore is virtually unsaleable. Consumers have large stocks and have no need to enter the market. The nominal price of best Rubio is 14s. 6d. c.i.f. Tees. The demand for blast-furnace coke shows no improvement, and the delivered price is weak at 14s. 6d.

Manufactured Iron and Steel.

In the manufactured iron and steel trade conditions are irregular. A rather better demand is reported for heavy material, but specifications are nearly all for small tonnages involving frequent changes of rolls. The sheet trade is fairly steady at the new minimum rates.

The Coal Trade.

The Northern coal trade is much more active than for some time past. There is no improvement in prices, however, but it might not require much more trade to give them a fillip. Shipments on recent contracts have begun, and they are helping to swell the export figures. Fresh inquiries are not numerous, but a few more orders are expected on tenders which have just been forwarded. A fairly good supply of Northumberland steam coal is on offer, but the undertone is firmer for all the favourite qualities. The scarcity of prompt tonnage prevents shippers from stemming fully up to contract, but on the whole the position is quite comfortable. Best Northumberland steams are firm at 13s. 6d., and prime Wear steams are sparingly offered at 15s. to 15s. 1½d., while Tyne primes are offered in moderate volume at 12s. 9d. Other secondary descriptions are irregular and readily obtainable at 12s. to 12s. 6d. Steam small output is larger than in recent weeks, but stocks are being steadily cleared, prices showing no quotable change. Best Northumberland smalls command 8s. 6d., Tyne prime 9s., and Wear prime 11s. to 11s. 1½d. Second Northumberland smalls are steady at 8s. New inquiries for Durham gas coals are coming forward steadily, though sellers cannot secure better prices; but the general position points to a steady market over the next month or two. Best qualities are firm at 14s. 6d., and special Wear gas at 15s. Secondary kinds move slowly, and show an easy tendency at 13s. to 13s. 6d. There is a very limited demand for coking unscreened, and also for ordinary bunkers, and these grades can be picked up at minimum values, coking at 12s. 6d. to 13s. 3d. and bunkers at 13s. First grade bunkers are in moderate supply, and steady at 13s. 6d. to 13s. 9d. The coke market rules quiet. Demand for gas coke is sustained, but owing to only odd parcels being available, trading is slow, prices holding to 17s. 6d. for best qualities. Patent oven coke is steady in tone, but supply is fully up to requirements, with values quietly steady at 14s. 6d. Coke nuts are steady at 16s. to 18s.

To Secure Greater Efficiency.

Thousands of men employed by the Hartley Main Collieries, Ltd., at their eight collieries throughout East Northumberland are being asked to co-operate with the management in devising means of improving the existing methods of production and distribution. To obtain the workmen's co-operation, the management has instituted a suggestion scheme, which offers each employee an opportunity of putting forward inventions or proposals to lead to greater efficiency in his particular grade of work or department. In order that every workman shall have an

equal opportunity, suggestions are sought under three sections—mining, workshops, office and general.

Blast-furnacemen's Wages.

A further fall in the net average realised price of No. 3 Cleveland pig iron is reported, the accountants' figure for the third quarter of the year being 51s. 10·5d. per ton, compared with 52s. 8·25d. per ton in the second quarter. In accordance with the sliding scale arrangement, the wages of blast-furnacemen on the North-East Coast will remain unaltered for the fourth quarter of 1932, *i.e.*, neither base rates, nor bonus, will carry any percentage for the current quarter.

Wage Reduction Claim Waived.

Cleveland ironstone mineowners and owners of Weardale limestone quarries have again shown a generous attitude towards their workers. Under the quarterly ascertainment they were entitled to a reduction of 1 per cent. in the men's wages, but on the appeal of the men's representatives they agreed to waive their claim. The men's representatives were reminded, however, that concessions which had been made during recent quarters could not go on indefinitely.

SCOTLAND.

(From our own Correspondent.)

Steel.

THE production of heavy steel has not increased to any extent of late, but makers are hopeful of increased activity in connection with recently placed naval contracts and probable mercantile orders. Meanwhile, plates and sections have only meagre specifications. The demand for steel for structural purposes is not particularly brisk at present.

Steel Sheets.

The demand for sheets has shown a distinct improvement of late, on both home and export account in respect to sheets of the lighter varieties. Further orders have come from Canada and more business is being done with Central America, Mexico, and the Far East. The turnover in galvanised sheets also shows improvement, and producers are now more regularly employed. In view of the higher costs of sheet bars and spelter, an advance in the price of sheets was inevitable, and last week the quotation for 24 gauge black was increased to £8 5s. per ton, and for 24 gauge galvanised corrugated to £10 per ton f.o.b. Glasgow.

Tubes.

There is a slightly improved inquiry for tubes, and some producers are busy on orders for shipment to Australia.

Iron.

So far as bar iron is concerned, no improvement falls to be recorded. The turnover in tube hoops for shipment to Canada has been considerably lower than usual up to date, and it is not expected that much improvement can take place as the last sailing this season is due on November 3rd. Producers of re-rolled steel bars have still to face stern competition from Continental material, despite the depreciation of sterling and tariffs. Prices are unchanged at £6 10s. home, and £6 5s. per ton export.

Pig Iron.

During the past week 2000 tons of pig iron arrived in this district from Calcutta, and 500 tons from England. Demands from local makers continue on a restricted basis, and are easily supplied from stocks. Prices are unchanged.

Scrap.

The demand for scrap material is not developing and quotations are still inclined to ease, with current prices about 45s. for cast iron machinery, and 32s. 6d. per ton for heavy steel.

Coal.

Owing, in a measure, to a seasonal development on home account, and better shipments coastwise and abroad, the market has hardened somewhat and the collieries have intimated an increase of 1s. 6d. per ton in prices for land sale. It is possible that supplies for shipment may become scarce owing to the reduced production quota for the next three months, and in view of this the prices of round fuels are inclined to harden, while business is of a day-to-day character. The firmness of washed nuts is still the outstanding feature of the market. All sizes are well bought, but especially treble nuts in Fifeshire, which are now quoted from 16s. to 17s. 6d. per ton. Aggregate shipments amounted to 264,638 tons, against 257,258 tons in the preceding week, and 247,544 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

ALTHOUGH recent returns of shipments do not afford much satisfaction, there appears to be a shade more activity even in steam coals, while anthracite qualities are as strong as ever, and the loading pressure is heavy. It is quite true that last week there was a slight falling off in the general volume of chartering, but, nevertheless, there are more orders on the market at the present time, and for some directions merchants are not finding it at all easy to secure their tonnage requirements at the rates of freight operating a few weeks ago. In the short trades, especially for French ports, rates have advanced from 9d. to 1s. per ton, and this is affecting the rates ruling for the North Spanish destinations, but for the Mediterranean ports and for South America new orders are slow to make their appearance. There is no doubt that France is taking increased quantities of coals from this area, notably dry descriptions, and wherever possible anthracite coals, but as regards some of the latter qualities, reports indicate that collieries are fully booked for the next month or so, if, indeed, not right up to the end of the year. Foreign coaling stations have of late been taking rather more supplies of steam coals, and there are a few contract inquiries about, the most important being that for 270,000 tons of small coals for the Portuguese State Railways, to be delivered over various periods from November of this year to the end of December, 1933. Tenders have to be in on the 21st inst., and the coals are for delivery at Lisbon and Oporto. Another inquiry is for account of the Kenya and Uganda Railways and Harbours, the quantity being 90,000 tons of locomotive coals for delivery in cargoes of 5000 to 6500 tons from early in February next over a period of twelve months at Kilindini. Perhaps it is too much to expect that this order will come to South Wales, as this district will be in severe competition with South African coals, but without doubt an effort will be made to bring the business to South Wales. The Jamaica Railways are also in the market for a cargo of steam coals of 6000 tons. In the case of the requirements of the Egyptian State Railways for 22,000 tons of sized coals, tenders have been sent in, and that of Messrs. Moxey, Savon and Co., of Cardiff, is reported to be the lowest. The business has not as yet been actually allocated. For the other inquiry of the Egyptian State Railways, viz., 50,000 tons of locomotive coals, tenders do not go in until well into December.

Anthracite Coals Busy.

At the end of last week there were five steamers waiting to load coals at Swansea, and as the result of arrivals over the week-end the position on Monday was that this figure had increased to twelve. The pressure on the loading facilities at Swansea has been so pronounced that many shipowners have lately displayed a definite indisposition to send their steamers to that port to load, on account of the long loading turns they may have to put up with. In contrast with this state of things, it may be pointed out that at the ports between Newport and Port Talbot there were on Monday twenty-four idle tipping appliances, though this number was lower than usual. As regards shipments of steam and anthracite coals from the six ports under the control of the G.W.R. Company, the total last week came to 393,035 tons, which compared with 351,100 tons for the preceding week and with 478,716 tons for the corresponding period of last week. Whilst the total for last week was the best for any week since August 20th last, the fact remains that the figures for Newport alone were the worst for the whole of this year, the quantity being only 25,680 tons whereas for the corresponding period of last year the total was 82,529 tons.

Facilities at Cardiff Docks.

The Cardiff Parliamentary Committee met on Monday to consider the report of the special committee which was recently appointed to investigate the allegations concerning the complaint that certain coal shipment appliances at the East Dock had been dismantled, thus seriously prejudicing Cardiff in its competition with the other adjoining docks. In view of the fact that the report disclosed a most unsatisfactory state of things, members of the special committee were appointed as a deputation to the Great Western Railway Company to protest against an alleged failure on the part of the railway company to carry out the "gentleman's agreement" arrived at in 1921 with regard to the maintenance of the shipping appliances at Cardiff docks in such a manner as not to prejudice Cardiff's interests in comparison with the company's other docks in the Bristol Channel. The Town Clerk was requested to arrange an early interview with the company.

Traffic Returns for September.

Although not as good as those for the month of July, the returns of traffic at the six ports in this channel under the control of the Great Western Railway Company for the four weeks ended September 25th were better than those for August. The aggregate of imports and exports came to 1,938,684 tons, made up of imports 289,242 tons and exports 1,649,442 tons, whereas for August the total was 1,765,321 tons, comprising imports 255,784 tons and exports 1,509,537 tons. For the whole of this year to September 25th imports aggregated 19,147,396 tons, which compares with 20,494,140 tons. Exports were down 1,003,309 tons, coal and coke shipments being responsible for 941,452 tons of this deficiency. On the import side the total was 2,557,721 tons, which was less by 343,435 tons than the corresponding period of last year.

Trimmers and Unemployment Benefit.

The Cardiff Court of Referees has decided that Penarth coal trimmers not participating in the wages pool are entitled to unemployment benefit. Similar applications recently on behalf of trimmers at the Cardiff East and West Docks, and also the Barry No. 1 section, were recently granted, with the result that altogether about 300 trimmers who are standing off periodically receive unemployment benefit.

Contracts.

The Cardiff Electricity Committee has decided to enter into contracts for modifications to the existing switches at the Cardiff power station at a cost of £10,265 and for new switches at £7885.

Current Business.

Outside anthracite coals, the demand for which cannot be met promptly, the inquiry is chiefly for dry-sized qualities, and nuts are quoted up to 31s. Dry large coals are also in better demand, but for other grades there is no special feature. Large steam coals are still in need of prompt orders. Patent fuel is a shade steadier, and coke moves off fairly freely. Pitwood has slightly recovered, but not appreciably, and prices are about 19s. to 19s. 6d.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE BETTER LINES COMPANY has changed its London offices and is now at 32, Shaftesbury-avenue, W.1. Telephone number, Gerrard 4881.

LAIDLAW, DREW AND CO., Ltd., inform us that in the future their address for correspondence will be 52, Frederick-street, Edinburgh; telephone number 24941. The firm's works will remain at Gilmour-street, Edinburgh, 8.

BUCK AND HICKMAN, Ltd., inform us that they have been appointed the sole agents in this country for the Shield arc welding machines and welding appliances manufactured by the Lincoln Electric Company, of Cleveland, Ohio.

WE have received from Murex Welding Processes, Ltd., a syllabus relating to three separate courses of instruction for operators, foremen, and designers in electric arc welding. The courses are described as intensive in character and are intended to cover their separate fields in a minimum of time. A small fee is charged to cover the cost of material used by the student.

CONTRACTS.

VAUGHAN CRANE COMPANY, Ltd., has received an order for four 15-ton four-motor cranes and one 5-ton crane for the London and North-Eastern Railway Company's locomotive works at Darlington.

NEGRETTI AND ZAMBRA have received a contract for the supply of forty-one mercury-in-steel distance dial thermometers for each of the four new cruisers, H.M.S. "Leander," "Orion," "Neptune," and "Achilles."

CYCLE-FILMS.—Our attention has been called by Dance-Kaufmann, of 18, Upp. Stanhope-street, Liverpool, to an ingenious application of cinematograph films for demonstration purposes. "Cycle-Films," as they are called, are made up in lengths which show some particular cycle, as, for example, the wave form of a rotating field, the action of epicyclic gears, generation of cycloid, gear pumps, &c. The films are in the form of continuous strips and may be run through the projector as frequently as desired. Thus, a lecturer may exhibit a film and discourse about the action which is visible the whole time to his audience. The films are available in three standard sizes, are not inflammable, and are extra tough, so that their life should be long. Prices vary, of course, according to the length of the "cycle." It seems to us that the device should have many useful applications.

PITMAN'S ENGINEERING EDUCATOR.—We have just received from Sir Isaac Pitman and Sons, Ltd., Part I. of their "Engineering Educator," which is to be completed in about thirty fortnightly parts. The scheme of the series is to cover the whole of mechanical engineering from fundamentals, through workshop practice and metallurgy, up to the finished products. The general editor is Mr. W. J. Kearton, M.Eng., A.M.I. Mech. E., who will be assisted by numerous specialists. This first part, comprising nearly fifty quarto pages, is wholly devoted to Mathematics for Engineers, and has been written by Mr. W. G. Bickley, well known to "C. and G." men. It is sufficiently elementary to suit the tyro, but covers in a short space an astonishingly wide field. Following Mathematics the Slide Rule is to be dealt with, and then will come articles, or chapters, on Machine Construction and Drawing. The foundations having been laid, attention will be given to Mechanics, Properties and Testing of Materials, Power Transmission, Pumps and Structural Steel Work. In the section given up to Metallurgy the Blast-furnace will be considered. A good deal of space has been allotted to Workshop Practice in all its branches, and power engineering of all kinds and a section on the Theory of Heat Engines will be included. We note with pleasure that the history of engineering is not to be neglected. Examination of Part I. shows that the series is being printed in clear type on a good-quality paper. The price is 1s. 3d. each part, and we have no hesitation in saying—as far as one may judge from a single sample—that the work should be useful to the student and young engineer.

CORNWALL AS A CRADLE OF SCIENCE AND ENGINEERING.—At the opening meeting of the winter session of the Junior Institution of Engineers, Mr. S. J. Crispin recalled the part played by Cornwall and the men famous in the engineering world who were born or worked in that county. Amongst these, Trevithick was one of the outstanding figures, and the information given concerning his work was particularly appropriate in view of the celebration next year of the centenary of his death. It was stated that the first use of the exhaust steam in a locomotive to force the draught was not due to Trevithick. The steam blast was greatly improved by another Cornishman, Sir Goldsworthy Gurney, and his system was used by Stephenson in the "Rocket" and by Hackworth in his "Sanspareil." Other names famous in engineering and the work for which they are specially noteworthy were referred to, amongst them Savery, born at Modbury, who first applied steam to the pumping of mines, his system relying on the pressure of steam to expel water from egg-shaped vessels into which it had previously been drawn from the mine by filling the vessels with steam and then condensing it to create a vacuum. The work of Newcomen and Crawley, of Dartmouth, who introduced the atmospheric beam engine for pumping was referred to. Some of these were of large size, one at Wheal Fortune, built in 1720, had a cylinder 4ft. in diameter, made 15 strokes per minute, and raised a hogshead of water 180ft. at each stroke. Smeaton erected an engine on the same principle at Chacewater in 1775 of 76 H.P., with a 6ft. diameter cylinder. It consumed £3000 worth of coal per year, and worked at a pressure of 7½ lb. The appearance of Watt and Boulton in Cornwall was noteworthy for their introduction of the closed cylinder, and the use of steam pressure to drive the piston downwards. Hornblower, of Redruth, was a competitor of Watt, and was later employed by him, making many improvements in the Watt engine and improving the rotary engine or turbine. Holmans, of Cambourne, continued the work of these pioneers, a noteworthy erection of theirs being the engine at the Phœnix Mine, near Liskeard. Another Cornishman, Murdoch, was associated with the earliest attempt to utilise steam for locomotion and was also the first to light a dwelling by gas. In describing the difficulties of obtaining suitable engineering material at the end of the eighteenth century, it was stated that the work of Trevithick and Vivian was much hindered by inability to obtain wrought iron plates for boilers larger than about 4ft. by 1ft. A Cornish mathematician, Davis Gilbert or Giddy, rendered great assistance to these early engineers by his technical knowledge. In 1778 Humphrey Davy was born at Penzance, the prelude to his brilliant career as a physicist and chemist being a small post at the Bristol Pneumatic Institute. Another Cornishman who did almost as much as the inventor of the Davy lamp for the safety of miners, was Bickford, who invented the safety fuse for exploding blasting cartridges. Finally, one of the best-known names in the engineering world, that of Tangye, comes from Cornwall. The founder of the engineering eminence of that firm lived in St. Columb in 1776, farmed for ten hours a day, worked a mine engine for seven hours, and said he wasted the rest.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	16/6 to 20/-
(1) Spanish	17/- to 23/6
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	14/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 7 6	—
No. 1 Foundry	3 10 0	—
No. 3 Foundry	3 7 6	—
N.E. Coast—		
Hematite Mixed Nos.	2 19 0	2 19 0
No. 1	2 19 6	2 19 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
Midlands—		
(c) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (a) / 4 0 6 (b) / 4 5 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	9 15 0	9 5 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 5 0	—
Common Bars	9 5 0	—
Best Bars	10 5 0	—
Double Best Bars	10 15 0	—
Treble Best Bars	11 5 0	—
Lancs.—		
Crown Bars	9 15 0	—
Best Bars	10 5 0	—
Hoops	12 0 0	—
S. Yorks.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	9 0 0 to 9 15 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 0 0 to 8 10 0	—
Gas Tube Strip	10 7 6 to 10 10 0	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates (Marine)	9 0 0	8 10 0
„ „ (Land)	—	—
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 15 0	7 15 0
Sheets (Gal. Cor. 24 B.G.)	11 0 0	10 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	7 2 6	—
Soft Billets	5 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
Manchester—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 15 0 to 7 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 10 0 to 8 12 6	—
Sheffield—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	5 15 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
Midlands—		
Small Rolled Bars (all British)	7 0 0 to 7 5 0	—
Small Re-rolled Bars	6 7 6 to 6 10 0	—
Billets and Sheet Bars	4 17 6 to 5 7 6	—
Galv. Sheets, f.o.b. L'pool	10 0 0	—
(2) Staffordshire Hoops	9 10 0	—
(d) Angles	8 7 6	—
(d) Joists	8 15 0	—
(d) Tees	9 7 6	—
(d) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 7 6 to 8 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14 f.o.b.	15/9 to 16/-
Block Tin (cash)	149 7 6
„ (three months)	150 10 0
Copper (cash)	31 15 0
„ (three months)	31 17 6
Spanish Lead (cash)	11 16 3
„ „ (three months)	12 2 6
Spelter (cash)	14 12 6
„ (three months)	15 0 0
Manchester—	
Copper, Best Selected Ingots	35 10 0
„ Electrolytic	37 10 0
„ Strong Sheets	65 0 0
„ Tubes (Basis Price), lb.	0 0 10½
Brass Tubes (Basis Price), lb.	0 0 9½
„ Condenser, lb.	0 0 11½
Lead, English	14 0 0
„ Foreign	12 5 0
Spelter	15 0 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10½ per lb.	
Ferro Tungsten	1/7½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£25 0 0	8/-
„ „ 6 p.c. to 8 p.c.	£24 10 0	7/6
„ „ 8 p.c. to 10 p.c.	£23 5 0	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£37 0 0	11/-
„ „ „ 1 p.c. carbon	£44 10 0	14/-
„ „ „ 0·70 p.c. carbon	£46 0 0	16/-
„ „ „ carbon free	1/1 per lb.	
Metallic Chromium	2/9 per lb.	
Ferro Manganese (per ton)	£10 15 0 for home	
„ „ „	£9 15 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£13 10 0 scale 5/- per unit	
„ „ 75 p.c.	£19 0 0 scale 6/- per unit	
„ Vanadium	12/6 per lb.	
„ Molybdenum	6/3 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£245 0 0	
Ferro Cobalt	7/9 per lb.	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	12/6
„ „ Ell	14/-
„ „ Splint	13/9 to 15/3
„ „ Trebles	14/- to 14/6
„ „ Doubles	12/6
„ „ Singles	10/6 to 10/9
Ayrshire—	
(f.o.b. Ports)—Steam	11/6
„ „ Jewel	16/6
„ „ Trebles	14/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	11/- to 13/6
Screened Navigation	16/6
Trebles	16/- to 17/6
Doubles	12/6 to 14/-
Singles	10/6 to 11/-
Lothians—	
(f.o.b. Leith)—Best Steam	11/6 to 12/-
Secondary Steam	11/-
Trebles	14/6
Doubles	12/- to 13/-
Singles	10/6 to 10/9

(8) N.W. Coast— ENGLAND.

Steams	21/-
Household	32/6 to 52/6
Coke	19/- to 22/6
Northumberland—	
Best Steams	13/6
Second Steams	12/3 to 12/6
Steam Smalls	8/6
Unscreened	12/6 to 13/-
Household	27/- to 39/-
Durham—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	24/-

Sheffield—	Inland.	Export.
Best Hand-picked Branch	27/- to 28/-	—
South Yorkshire Best	23/- to 24/-	—
South Yorkshire Seconds	19/- to 21/-	—
Derbyshire Best House	22/- to 23/6	—
Derbyshire Best Brights	18,- to 20/-	—
Screened House Coal	18/- to 19/-	—
Kitchen Coal	16/- to 17/6	—
Best Screened Nuts	16/6 to 18/6	—
Small Screened Nuts	15/6 to 16/6	—
Yorkshire Hards	17/- to 18/-	—
Derbyshire Hards	17/- to 18/-	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	7/- to 8/6	—

Blast-furnace Coke (Inland).. 10/- on rail at ovens
Furnace and Foundry Coke (Export), f.o.b., 14/6 to 15/6

(9) SOUTH WALES.

Cardiff—

Steam Coals:	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/- to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	19/- to 31/-
No. 3 Rhondda Large	19/6 to 19/9
„ „ Smalls	15/- to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/6 to 36/6
Furnace Coke (Export)	17/- to 18/-
Patent Fuel	20/-
Pitwood (ex ship)	19/- to 19/6

Swansea—

Anthracite Coals:	
Best Big Vein Large	36/- to 38/6
Seconds	27/- to 34/-
Red Vein	22/- to 26/6
Machine-made Cobbles	37/6 to 48/6
Nuts	36/6 to 48/6
Beans	28/6 to 32/6
Peas	19/6 to 21/-
Breaker Duff	8/6 to 9/6
Rubbly Culm	10/6 to 10/9
Steam Coals:	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate: Joists (minimum), 23/6: Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (e) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

The Steel Trade.

STEEL makers are much perturbed at the way in which anti-dumping restrictions are excluding them from the United States' market, and though a collective protest has had the effect of alleviating those restrictions to a certain extent, it is yet feared that the barrier is still too high to permit of steel consignments to America. The quoting of merchant bars down to £2 8s. per ton and even less f.o.b. Antwerp was bound to cause other countries to protect their own steel industries, with the result that French and Belgian makers are finding it more and more difficult to enter foreign markets. The Luxemburg group believes that matters have gone far enough, and it has agreed to fix a minimum quotation of £2 8s. 6d. a ton, which is noteworthy as being the first step so far made to control prices. Such a control has become all the more necessary because there is an impression that the situation is improving, at least to the extent of consumers being obliged to renew depleted stocks. Recent buying has certainly had the effect of giving rise to a little more confidence. Belgian makers now recognise that the controlling influence of the Steel Cartel at this moment would be of benefit to the industry, and it is reported that they are on the point of settling amongst themselves the question of their quotas, so that negotiations for the reconstruction of the Cartel may be renewed at an early date. Meanwhile, a report was presented a few days ago by the Aciéries de Longwy giving figures that show a considerable contraction of the French steel production, which is now about 5,600,000 tons, and also the ruinous level to which export prices have fallen. The report affirms that it will be difficult for French steel makers to recover foreign markets so long as the industry is burdened by taxes and charges which, in gold francs, are eight times more than they were in 1914 and which represent 36 per cent. of the steel export prices. Makers have no alternative at the moment but to preserve the home market, which can only be done by means of import quotas, and the report emphasises strongly the necessity of the quotas being maintained until such time as international trade settles down on a normal basis.

Cultivating Machines.

During recent years the demonstrations of tractors and other cultivating machines that were formerly important annual events at Buc, near Versailles, have been held intermittently, and last week the exhibition and demonstrations of such machines organised by the Ministry of Agriculture at Essonnes, near Corbeil, showed a notable falling off in the support given to them by manufacturers. This result may be accounted for by the depressed state of the agricultural industry, and by the fact that the present types of machines, while efficient and serviceable, are required to fulfil many varied working conditions which introduce an element of doubt amongst farmers as to whether their own particular needs can be satisfactorily met by the machines offered. As France is the one country where agricultural labour is scarce, and has to be supplemented by foreign immigration, the opportunities for selling tractors would appear to be particularly promising. The machines interest farmers, and a large number of them are employed, but the business has dwindled until the situation of tractor builders is anything but satisfactory. Big tractors that are indispensable on the cornfields in North Africa, where there is hardly any labour, find little scope in this country, and the smaller machines must possess qualities of adaptability and economy that farmers are doubtful of finding in many of those at present on the market. Nevertheless, the prospective user knows that tractors will eventually be his salvation when the agricultural industry is sufficiently prosperous to allow of money being invested in their purchase, and when there is a certainty of realising economies in carrying out intermittent work on a medium-sized farm. This latter point depends largely on fuel consumption, which has already been brought down to a low figure by the use of heavy oils, and German manufacturers have led the way with solid injection engine tractors that were again a prominent feature at the Esonnes gathering. The French have not made anything like the same progress in small solid injection engines, for Renault is the only maker that has produced such a prime mover for lorries and agricultural tractors, and probably the most promising type of engine is the "Lister," which was fitted to a French tractor. The light high-speed solid injection engine appears to be the real solution of the tractor problem. Seeing that the tractor aims at reducing farmers' costs, it is abnormal that it should be the first to suffer from the depression, though this state of things may change when tractors and other cultivating machines are definitely accepted by all classes of agriculturists. It is reported that in Hungary only 1700 agricultural tractors are now employed out of a total of 7000, many farmers having reverted to horses, partly as a means of providing employment for men who are now willing to work for lower wages.

The Super-liner.

When the mechanics at the Penhoët shipyard threatened to strike against a reduction of wages the builders declared that any stoppage of work on the super-liner would delay its launching until the spring, in which event a large number of men would be thrown out of work for several months. The operatives thereupon withdrew their threat, and the date for launching the ship has been fixed for the 29th inst. It is denied that the new liner will be named the "President Doumer," which it is proposed to give to a battleship, and the name of the liner will only be revealed at the last moment. The Compagnie Générale Transatlantique affirms that it has not found it necessary to utilise all the money placed at its disposal by the Treasury for the completion of the ship, and in a general way the economies effected are enabling the company to tide over the financial crisis, so that the launching of the liner will serve the double purpose of adding to the prestige of the French merchant marine and of reaffirming the vitality of the Compagnie Générale Transatlantique.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

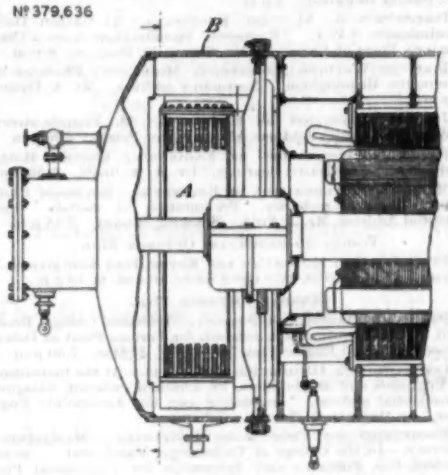
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

379,636. March 9th, 1932.—DYNAMO-ELECTRIC MACHINES, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C.2.*

This invention relates to totally enclosed dynamo-electric machines, and more particularly to an arrangement of surface coolers in such machines. The object of the invention is to provide a compact machine of this type in which the coolers A

Nº 379,636



can readily be removed. This is accomplished by providing a housing, and a removable end-head B for enclosing the machine, and baffles for directing cooling gas from the machine through the coolers in the end-head and for directing cooling gas from the end-head into the machine, the arrangement being such that the end-head with the coolers can be removed without displacing the bearing.—*September 1st*, 1932.

SWITCHGEAR.

379,817. July 21st, 1931.—ELECTRIC-FUSIBLE CUT-OUTS, Ernest Long, John Bromley, and Long and Crawford, Ltd., of 2, Gorton-road, West Gorton, Manchester.

This invention relates to combined switches and fusible cut-outs of the type commonly used in gear known as oil-immersed switch fuse gear, where on the rupture of the fusible element the circuit is further opened and the live terminals of the circuit separated by a spring or springs acting upon a switch member in series with the fusible element without ultimate separation of the terminals of the fusible element. The object of the invention is to make the rupturing of the fuse element the means of releasing the spring-operated switch connected in series, so that the further opening of the circuit is accelerated without the further separation of the terminals of the fuse element, and without allowing the switch spring to exert any tension on the

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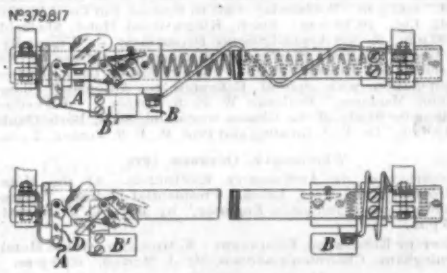

fuse element. One of the fuse terminals is carried by a stationary switch contact B^1, the second terminal being mounted on an arm D pivoted to hang vertically and act as a stop for a pivoted trip lever which on the rupture of a fuse releases the movable switch contact to separate the live terminals B^1 and B, the fuse normally preventing movement of the arm from a substantially vertical position. The rupture of the fuse trips a catch, which releases a spring-operated switch member, which, when released, separates the live terminals, the stress of the spring being normally fully imposed on the spring-operated switch member, and not directly associated with the members carrying the fuse element. Another feature of the invention, applicable for multiphase circuits where it is desirable to open all the circuits if one fuse blows, is the provision of further trip levers to release the contact springs on the other phases without damaging their fuses.—*September 8th*, 1932.

TRANSFORMERS AND CONVERTERS.

379,469. July 16th, 1931.—ELECTRIC TRANSFORMERS, Ferranti, Ltd., of Hollinwood, Lancashire, and Graham Leigh Porter.

The invention has for its object to provide means for reducing the kVA rating of the booster transformer. One end of the main portion of the secondary winding A of a transformer having a primary winding B instead of being connected to a tapped end portion C is connected to the junction D of the common portion E, and extended portion F of the winding of an auto-connected booster transformer separate from the main transformer. The tapped portion C of the main winding A is connected across the full winding E F of the booster transformer, the arrangement being such that the current traversing the tapped winding is opposed to the main current in the common portion E of the winding of the booster transformer. G is the tap-changing switch. If, for example, the main current is 10 per cent. above the switch rating, the common winding of the booster need only be rated

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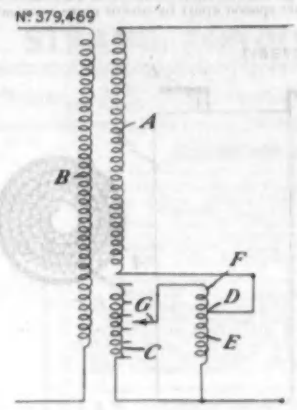

at 10 per cent. of the switch rating, which is equivalent to one-eleventh of the main current. Consequently, the kVA rating of the booster is considerably reduced.—*September 1st*, 1932.

CRANES AND CONVEYORS.

379,566. November 20th, 1931.—PULLEY BLOCKS, Treuils et Palans, 55, rue de Chateaudun, Paris, France.

With the usual arrangement of chain pulley block the hoisting hook is out of line with the suspension hook, with the result that the block oscillates as it takes up the load and the chains are

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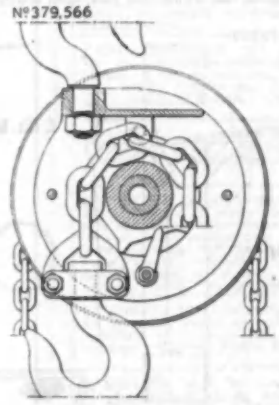

liable to get entangled. As a result the inventors make the frame of the block of a steel casting and arrange the suspension hook directly above the hoisting hook, as shown in the illustration.—*September 1st*, 1932.

MACHINE TOOLS AND SHOP APPLIANCES.

379,254. April 14th, 1932.—ELECTRIC SOLDERING IRONS, F. Dupau, 3 rue Le Brun, Paris, France.

In this soldering iron the solder is melted within the body of the bit and is applied to the joint through a narrow orifice terminating at its point. The bit is shown at A and is heated by the electrical resistance elements B, B. Within it there is

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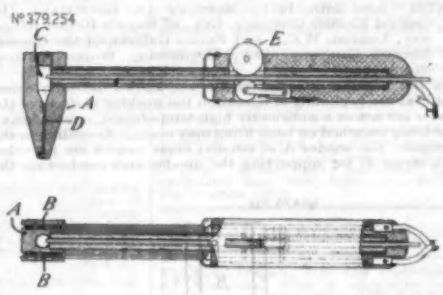


cored out a recess C into which the wire of solder is projected through the hollow handle. The solder is melted off the wire in this recess and is conveyed down to the work through the fine passage D. The knurled wheel E provides a simple means of feeding the solder wire forwards by the thumb.—*August 25th*, 1932.

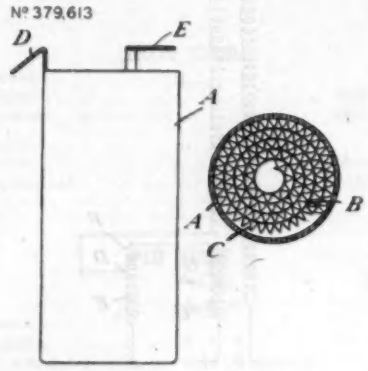
MISCELLANEOUS.

379,613. January 26th, 1932.—ELECTROLYTIC CONDENSERS, N. V. Philips' Gloeilampenfabrieken, of 13d, Eindhoven, North Brabant, The Netherlands.

The invention relates to an electrolytic condenser in which the various plate-shaped electrodes or the various successive turns of a single electrode are arranged at some distance from one another and are separated by an intermediate layer. The condenser plates of electrolytic condensers are frequently rolled up in order to save space. The intermediate layer by which the turns of the electrodes are spaced apart from one another consists in many cases of an absorbent substance containing the electrolyte, for example, of asbestos or paper. It has been found that undesirable phenomena may occur owing to the fact that gases are developed in the electrolyte and that the intermediate layer, which is in contact with the electrodes, prevents the gas bubbles from ascending. At the point at which gas bubbles remain between the electrode and the intermediate layer the electrode will be corroded, which results in a considerable decrease of the

length of life of the condenser. According to the invention, a condenser vessel A, which acts as one of the electrodes, consists of iron, and a rolled-up electrode B therein consists of zirconium coated with a layer of zirconium oxide. The vessel is filled with a solution of potassium hydroxide. The successive turns of the electrode B are spaced apart by one or more corrugated strips C

No 379,613



of celluloid. The bottom of the vessel A, which consists of iron, provides sufficient electrical conductivity between the two electrodes. The terminal D of the condenser is directly connected to the iron vessel A and the metallic strip E connected to the electrode B passes through the cover of the condenser. It is evident that gas bubbles have an ample opportunity of ascending in the electrolyte.—*September 1st*, 1932.

379,559. November 9th, 1931.—Extruding Lead Cable Casings, Callender's Cable Construction Company, Ltd., Hamilton House, Victoria Embankment, London, E.C.4; and H. Hill, Belvedere Works, Belvedere, Kent.

It is pointed out that in the process of covering a cable with a protective sheathing of lead, by the extrusion process, some difficulty may arise through the non-adhesion of a charge when poured upon one which has just been nearly exhausted.

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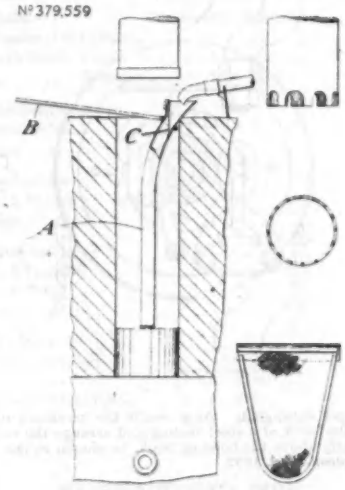
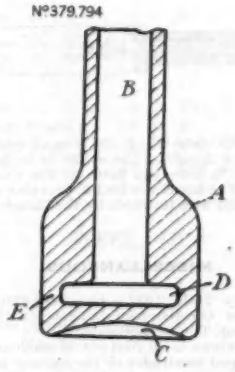


This lack of adhesion is accounted for by the fact that a skin of oxide forms on the surface of the old charge. As a consequence the inventors introduce the new charge through a spout A, which is manipulated by hand through the handle B. There is a strainer at C to hold back solid matter. The spout is so manœuvred that the fresh charge melts into the surface of the old charge in a series of craters and welds the two together, while any oxide film is flushed away to the sides and top.—*September 1st*, 1932.

379,794. June 24th, 1931.—Mercury Arc Rectifiers, The General Electric Company, Ltd., of Magnet House, Kingsway, London, W.C.2, and Enrico Gallizia, of the General Electric Company, Ltd., Engineering Works, Witton, Birmingham.

In the working of rectifiers the well-known difficulty arises that if at the beginning of operation the working surfaces of the anodes are not at a sufficiently high temperature, upon a heavy load being switched on back firing may occur. According to the invention, the anodes A of circular cross section are provided with stems B for supporting the anodes and conducting the

No 379,794



current. The working surfaces of the anodes, which are somewhat concave, are shown at C. The anode A and the stem B are in one piece, and may be constructed, for example, of iron. In another form of construction, however, the anode and stem are separate from one another and may be of the same metal, or the anode A may be of graphite and the stem B of steel, or other suitable material. The bore of the hollow stem B is extended into the anode A to a point near the working face C, and at the extremity of the bore an annular groove D is formed whereby the portion of the anode adjacent to the working face and the main portion A are separated by a ring of like portion E of relatively small cross-sectional area.—*September 8th*, 1932.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Tuesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

To-day.

Chemical Engineering Group.—At Burlington House, Piccadilly, W.1. "Colloidal or Coal-oil Fuel," by Professor J. S. S. Brame. 8 p.m.

Institute of Metals: Sheffield Local Section.—In the Non-ferrous Section of the Applied Science Department of the University, St. George's-square, Sheffield. Chairman's Address, "Annealing." Captain F. Orme. 7.30 p.m.

Institution of Engineers and Shipbuilders in Scotland.—Grosvenor Restaurant, Glasgow. "James Watt" dinner.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, S.W.1. Informal meeting. Discussion, "National Aspects of Pulverised Coal Firing." Introduced by Dr. Harold Heywood. 7 p.m.

Institution of Sanitary Engineers.—At Caxton Hall, Westminster, S.W.1. "Engineers' Specifications from a Contractor's Point of View," by Mr. Sidney H. Burgess. 6 p.m.

Inst. of Welding Engineers: Midlands.—Chamber of Commerce, Birmingham. Chairman's address. Mr. A. Dyson. 7 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W.1. Chairman's Address, Mr. J. Foster Petrie. 7.30 p.m.

Keighley Association of Engineers.—Queen's Hotel, Keighley. "Lubricated Bearings," Dr. H. W. Swift. 7.30 p.m.

Manchester Association of Engineers.—Engineers' Club, Albert-square, Manchester. Presentation of medals. Presidential Address, Mr. J. Frith. Smoking concert. 7.15 p.m.

To-day to Saturday, October 22nd.

International Motor Car and Motor Boat Exhibition.—Olympia, Kensington, W. Open daily, 10 a.m. to 10 p.m.

Monday, October 17th.

Bradford Engineering Society.—Technical College, Bradford. "The Selection of Lubricants for Various Plant as Determined by Actual Engine Test," by Mr. F. J. Slee. 7.30 p.m.

Institution of Automobile Engineers.—At the Institution of Engineers and Shipbuilders, 39, Elmbank-crescent, Glasgow. Presidential address, "Legislation and the Automobile Engineer," by Major C. G. Nevatt. 7.30 p.m.

Institution of Production Engineers: Manchester Section.—In the College of Technology, Manchester. "Some Modern Gas Furnaces and Accessories for Economical Production," by Mr. S. N. Brayshaw. 7.30 p.m.

Wolverhampton and District Engineering Soc.—Victoria Hotel, Wolverhampton. Annual general meeting. Paper, "Glass and Glass Manufacture, Embodying Vita Glass," Mr. R. F. Taylor. 7.30 p.m.

Tuesday, October 18th.

Institution of Automobile Engineers: Wolverhampton Centre.—At the Engineering and Scientific Club, Queen-street, Wolverhampton. "Vehicle Springs," by Mr. C. Stirling. 7.30 p.m.

Inst. of Electrical Engineers: S. Midland Students' Section.—Midland Hotel, Birmingham. "High-voltage Electrification," Mr. G. H. Halton. 7 p.m.

Inst. of Electrical Engineers: Scottish Centre.—39, Elmbank-crescent, Glasgow. Chairman's address, Mr. D. H. Bishop. 7.30 p.m.

Inst. of Electrical Engineers: Midland Students' Section.—Hotel Metropole, Leeds. Address by Mr. R. O. Yardley. 7.30 p.m.

Institution of Heating and Ventilating Engineers: Associate Members' and Graduates Section.—All-day visit to Works of Crane, Ltd., Ipswich.

Sheffield Metallurgical Association.—196, West-street, Sheffield. "The Re-crystallisation of Strained Iron," by Mr. Hugh O'Neill. 7.30 p.m.

Tuesday and Wednesday, October 18th and 19th.

Society of Glass Technology.—King's Head Hotel, Sheffield. 4.45 p.m. Wednesday, visit to Pearson and Co. (Chesterfield), Ltd., 10.15 a.m.; lunch, King's Head Hotel, Sheffield, 12.30 p.m. In the Applied Science Department, the University, St. George's-square, Sheffield. Introductory address by the President, Mr. Edward Meigh. "The Scientific Basis of Glass Manipulation with Special Reference to Automatic Glass-forming Machines," Professor W. E. S. Turner; "A Further Systematic Study of the Glasses containing Soda, Boric Oxide and Silica," Dr. E. J. Gooding and Prof. W. E. S. Turner. 2 p.m.

Wednesday, October 19th.

Institution of Automobile Engineers.—At the Hotel Metropole, King-street, Leeds. Presidential address, "Legislation and the Automobile Engineer," by Major C. G. Nevatt. 7.15 p.m.

Inst. of Electrical Engineers: S. Midland.—Grand Hotel, Birmingham. Chairman's address, Mr. J. Morton. 6.30 p.m.

Institution of Heating and Ventilating Engineers: Associate Members' and Graduates' Section, Manchester and District Branch.—Engineers' Club, Manchester. Annual dinner. 7 p.m.

Institution of Locomotive Engineers (London): Birmingham Centre.—Room 178, Queen's Hotel, Birmingham. Presidential address, Mr. W. A. Lelean. 6.45 p.m.

Institution of Production Engineers: Birmingham Section.—Grand Hotel, Birmingham. "Economic Uses of Tungsten Carbide Tools," by Mr. J. H. Garnett and Mr. E. W. Field. 7 p.m.

Inst. of Welding Engineers.—At Inst. of Mech. Engineers, Storey's-gate, S.W.1. "Radiographic Examination of Welds," R. A. Stephen. 7.45 p.m.

Newcomen Society.—In the Lecture Theatre, Science Museum, South Kensington, S.W.7. "The Site of Newcomen's Engine of 1712," by Mr. T. E. Jones. 5.30 p.m.

Royal Microscopical Society.—B.M.A. House, Tavistock-square, W.C.1. Meeting at 5.30 p.m.

Thursday, October 20th.

Institute of Metals: Birmingham Local Section.—In the University, Edmund-street, Birminghan. Lecture by Sir Charles Grant Robertson. 7 p.m.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, W.C.2. Presidential Address, by Professor E. W. Marchant. 6 p.m.

Inst. of Locomotive Engineers.—36, George-street, Manchester. Presidential address, Mr. W. A. Lelean. 7 p.m.

Inst. of Mining and Metallurgy.—At the Geological Society, Burlington House, Piccadilly, W.1, Discussion, "The Genesis of the Perrunal-LaZarza Pyritic Orebody, Spain," Mr. Gordon Williams, Student. 5.30 p.m.

Institution of Production Engineers.—In the Institution of Engineers and Shipbuilders in Scotland, Elmbank-crescent, Glasgow. "Degrees of Accuracy Attainable in Modern Workshop Practice," by Mr. R. Eagleshan. 7.45 p.m.

Royal Aeronautical Society, Joint Meeting with the Institute of Rubber Industry.—At the Royal Society of Arts, John-street Adelphi, W.C.2. "Flying Conditions on the West Coast of Africa," by Flight-Lieutenant W. G. Pudney. 6.30 p.m.

Friday, October 21st.

Faraday House Old Students' Association.—Savoy Hotel, London, W.C.2. Twenty-fourth annual dinner. 6.30 p.m. for 7 p.m.

Institution of Mechanical Engineers.—At Connaught Rooms, Great Queen-street, W.C.2. Annual dinner. 6.45 p.m. for 7.15 p.m.

Institution of Production Engineers.—Holborn Restaurant, London, W.C.1. Annual general meeting, 6.30 p.m.; annual dinner, 7 p.m. for 7.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W.1. "Notes on Windmill Construction," by Mr. Rex Wailes. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Bolbec Hall, Newcastle-upon-Tyne. Presidential Address, by Mr. R. J. Walker. 6 p.m.

Saturday, October 22nd.

Institution of Heating and Ventilating Engineers: Associate Members' and Graduates' Section, Manchester and District Branch.—Visit to Mersey Tunnel, Liverpool.

Institution of Mechanical Engineers: Graduates' Section.—Visit to Neasden Power Station.

Monday, October 24th.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, W.C.2. Discussion, "The Future Prospect for Electrical Engineers." Opener, Professor E. W. Marchant. 7 p.m.

Institution of Mechanical Engineers: Graduates' Section.—London. "Experimental Work on a Marine Closed Feed System," by Mr. B. W. Pendred. 6.45 p.m.

Tuesday, October 25th.

British Association of Refrigeration.—In the Hall of the Institution of Mechanical Engineers, Storey's-gate, St. James's Park, S.W.1. Presidential Address by Sir William B. Hardy, F.R.S. 5.30 p.m.

Inst. of Electrical Engineers: N. Midland.—Hotel Metropole, Leeds. Chairman's address, Mr. R. M. Longman. 7 p.m.

Institution of Engineers and Shipbuilders in Scotland.—39, Elmbank-crescent, Glasgow, C.2. "A Note on the Development and Operating Results of 'Bauer-Wach' Installations," by Mr. R. J. Butler. 7.30 p.m.

Sheffield Metallurgical Association.—196, West-street, Sheffield. "Discussion on Pyrometry" in connection with Section V., Pyrometric Sub-committee, fourth report on Heterogeneity of Steel Ingots. This discussion will be presented by Messrs. A. Stanfield, Todd and Elcock. 7.30 p.m.

Wednesday, October 26th.

Chartered Institute of Patent Agents.—The Edward VII. Rooms, Hotel Victoria, Northumberland-avenue, W.C.2. Jubilee dinner. 6.45 for 7 p.m.

Institution of Automobile Engineers.—At the Engineers' Club, Albert-square, Manchester. Presidential address, "Legislation and the Automobile Engineer," by Major C. G. Nevatt. 8 p.m.

Inst. of Mechanical Engineers: Yorks. Branch.—University, Sheffield. "Causes of Brittle Fracture in Ductile Steels—or Metals," Prof. B. P. Haigh. 7.30 p.m.

Inst. of Welding Engineers.—College of Technology, Manchester. "Atomic Hydrogen Welding," Mr. J. Dorritt. 7.30 p.m.

Thursday, October 27th.

Inst. of Locomotive Engineers.—Inst. of Mech. Engineers, Storey's-gate, S.W.1. "Some Observations on the Practice of Providing Lead with the Piston of Slide Valves of Modern Locomotives," Mr. C. A. Cardew. Mr. H. Holcroft will read the paper. 6 p.m.

Inst. of Mechanical Engineers: Yorks. Branch.—Hotel Metropole, Leeds. "Causes of Brittle Fracture in Ductile Steel—or Metals," Prof. B. P. Haigh. 7.30 p.m.

Manchester Association of Engineers: Students' Section.—Y.M.C.A. (Restaurant Club Room), Peter-street, Manchester. "A General Talk on Machine Tool Drives," by Mr. K. W. D. Roberts. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders: Tees-side Branch.—Cleveland Scientific and Technical Institution, Corporation-road, Middlesbrough. Address by the President, Mr. R. J. Walker: Chairman's address, Mr. W. T. Butterwick. 7.30 p.m.

Royal Aeronautical Society.—At the Royal Society of Arts, John-street, Adelphi, W.C.2. "Aeroplane Covers and Wheels," Mr. F. Fellowes. 6.30 p.m.

Friday, October 28th.

Institution of Mechanical Engineers.—Storey's Gate, St. James's Park, S.W.1. General meeting, Presidential Address, by Mr. William Taylor. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W.1. "Electrical Engineering as Applied to Theatres and Cinemas," by Mr. R. Gillespie Williams. 7.30 p.m.

Manchester Association of Engineers. Joint Meeting with North-Western Branch of Institution of Mechanical Engineers.—Engineers' Club, Albert-square, Manchester. "Transport in Modern Engineering Works," by Mr. J. S. Taylor. 7.15 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Bolbec Hall, Newcastle-upon-Tyne. First Andrew Laing Lecture. "The Work of Andrew Laing," by Engineer-in-Chief of the Fleet, Eng. Vice-Admiral Sir Reginald Skelton, K.C.B. 6 p.m.

Saturday, October 29th.

Institute of Metals: Birmingham Local Section.—Queen's Hotel, Birmingham. Dinner and dance. 7 p.m.

Monday, October 31st.

Bradford Engineering Society.—Technical College, Bradford. "Oil Firing for Steam-raising Purposes," by Mr. F. L. Bolt. 7.30 p.m.

Engineers' German Circle (Deutscher Ingenieurzirkel in London).—At the Institution of Mechanical Engineers, Storey's-gate, St. James's Park, S.W.1. "Neue Konstruktionen von Dieselmotoren" ("New Designs of Diesel Engines"). Illustrated with lantern slides, by Diplom-Ingenieur R. E. Strub. 5.15 p.m. for 6 p.m.

Friday, November 4th.

Chelsea Polytechnic.—Manresa-road, S.W.3. Opening building extension. Presentation of Diplomas and Certificates. 8 p.m.